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IRRIGATION IN THE ARID STATES.

By CHARLES HOWARD SHINN.

ALMOST vital change is going on in the region west of central Kansas—a change which will in the near future profoundly affect many if not all classes of agriculturists in other American States, and incidentally in Europe also. I refer to the change that has been brought about by the success of private irrigation enterprises, by important alterations in the laws respecting irrigation, by district irrigation under such laws, and by the steady growth of a public sentiment favorable to the irrigator, even when his necessities override ancient precedent.

It is my purpose in this article to give, as far as may be, a faithful and conservative account of the present condition of arid-land irrigation enterprises. My account will be statistical as far as acreage, flow of water, cost of construction, and similar items; it will be descriptive, and largely from personal knowledge, as regards practical methods and their results. The entire subject, it seems to me, possesses an immeasurable interest for farmers elsewhere, and for all who are in any way dependent upon the farming class. Successful irrigation upon a large scale introduces, it is true, a new kind of competition, but it also urges intelligent farmers to adopt improved methods of farming in their own defense, and often leads them to apply the water of neglected streams upon their lands. Even the general reader is often interested in discussions upon farm mortgages, farm rents, wages of laborers, taxes on crops, cost of fertilizers, and similar agricultural problems of the present time, because he has learned that they affect his own welfare. Much broader is the application of arid-land irrigation to every occupation and industry. America

FIG. 1.—AQUEDUCT AT MISSION SAN JUAN.

has many and greater valleys of the Nile waiting to pour forth enormous harvests whenever the legislative and executive work of the irrigator has been accomplished.

If I were writing a history of irrigation in America—and a wonderful story it is—I should have to devote a chapter to the Spanish influence in all the lands from Texas to southern California, where men, whose mountaineer ancestors had learned the value of water in arid districts from the builders of the Alhambra, made reservoirs and led many a fertilizing stream to acres of vines and oranges on the high plains about old missions, or in the adobe-walled gardens of newly founded towns, such as San Antonio, Santa Fé, and Los Angeles. I should have to tell about the ruined irrigation canals of forgotten tribes in Arizona, southern Utah, and other regions of the Southwest where hundreds of square miles were covered with a network of water ditches, small and great. The modern irrigator often adopts the grades of these prehistoric channels for his enterprises, finding that no engineer can improve upon them. I should have to describe the fields under the red and yellow heights of Zuñi or Acoma, where the Pueblo Indians still raise their spotted corn by irrigation, as their ancestors did centuries ago, in the bottoms of narrow cañons where the ruins of their fortressed cliff-dwellings still remain. But these things, except perhaps for a passing allusion, are foreign to the purpose of this investigation.

The arid States and Territories are beginning to organize as a group of communities that have common interests and a common purpose. Their respective areas and populations are shown in the following table:

Name.	Area, square miles.	Population in 1890.
Texas	265,780	2,235,523
New Mexico	122,580	153,593
Arizona	113,020	59,620
California	158,360	1,208,130
Colorado	103,925	412,198
Utah	84,970	207,905
Nevada	110,700	45,761
Kansas (west of 97°)	56,000	807,000
Nebraska	76,855	1,058,910
Wyoming	97,890	60,705
South Dakota	149,100	328,808
North Dakota		182,719
Montana	146,080	132,159
Idaho	84,800	84,385
Oregon (eastern)	48,000	113,767
Washington (eastern)	35,000	149,390
Total	1,652,060	7,480,573

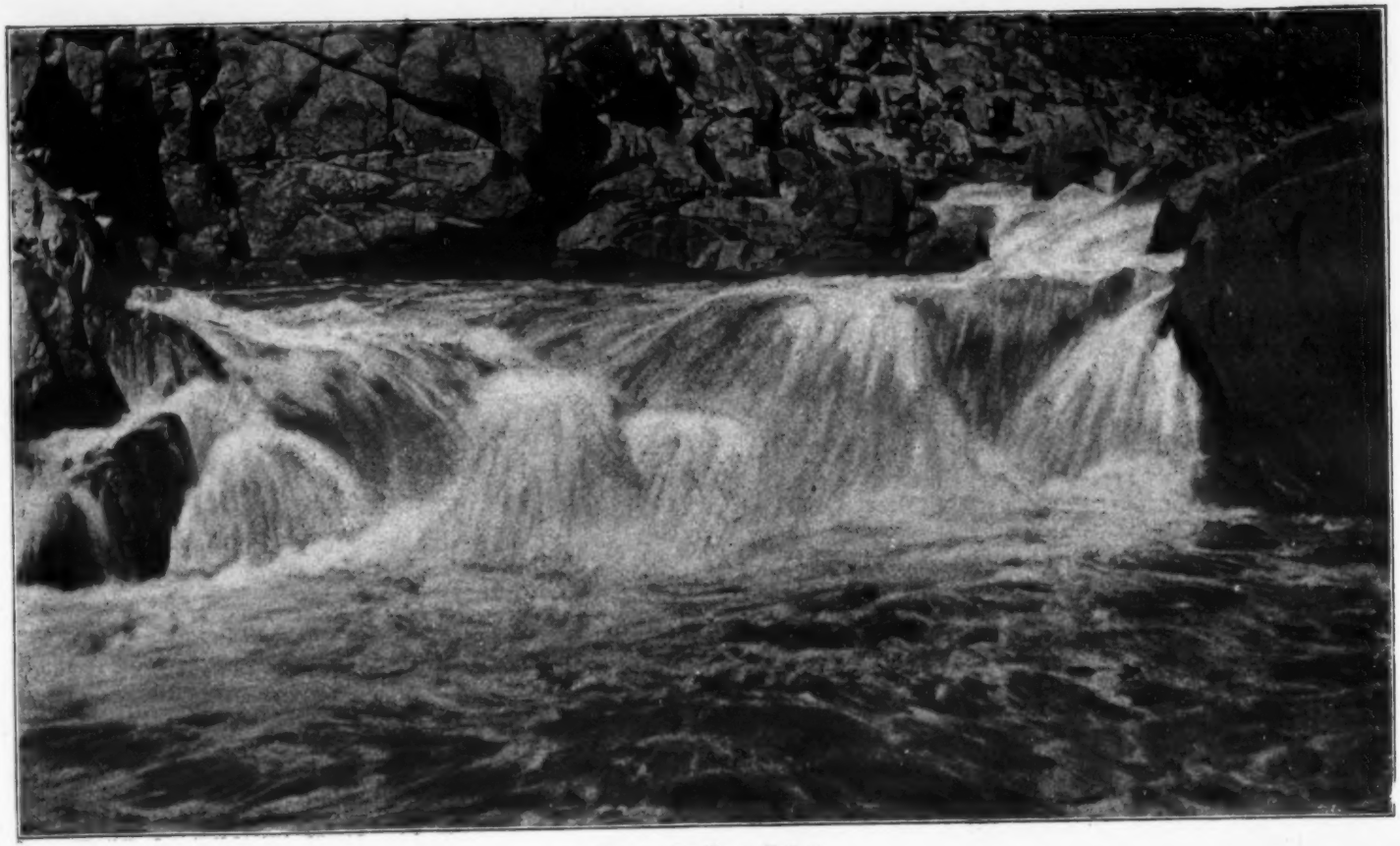

Fig. 2.—In Kern Cañon.

The total area is more than half of the United States (without Alaska), and the total present population is less than one eighth of the population of the United States.

It is difficult, perhaps impracticable, to divide States once created. Although a respectable minority in California and Texas favor division schemes, which would make of the former three States, and of the latter four, the tendencies of the time are against it. But with the Territories it is different; and if admission is long delayed, so that irrigation developments will have enabled the soil to sustain a dense population, such Territories as Arizona, New Mexico, and Utah are very likely to be divided. Eastern Oregon and Washington are separated by diverse interests from the western slopes of those States in somewhat the same way as southern California is separated from the northern counties. If the desire for smaller States should increase in the future, it is not impossible, therefore, that the States and Territories of the arid belt should some time contain twenty-five or thirty political divisions instead of sixteen, as at present. It is perhaps too much to say that the balance of power can ever be transferred from the Mississippi Valley to the ultimate West of the Rockies, the Great Basin, the valley of the Rio Grande, the irrigated leagues of the Nevada and Arizona deserts, the vast valley plains of the Sacramento and San Joaquin, the mountains of Coast Range, Cascade, and Sierra. But if such a change is ever brought about, the irrigator will be the principal cause of the transfer of leadership from the man of the corn lands to the man of the fruit lands.

Twenty years ago no one in America knew how to utilize water on a large scale for irrigation. A few colonies in different parts of the arid zone, a few settlers in isolated valleys, were making experiments. Half a dozen ranchers would come together and plow an open ditch two or three feet wide, to irrigate their crops in years of severe drought. As for the districts where the average annual rainfall was below the required amount, no one tried to live there. But some of the most successful of recent enterprises have been upon lands where there is "no rainfall." Even ten years ago, though the number of colonists had increased, the total area under water ditches in the arid region was hardly more than two million acres. In 1886 it had increased to five and a half million acres, and the following table shows the state of affairs in 1891:

Irrigated Areas in Arid Region.

State or Territory.	Acreage under ditch.	Acreage cultivated by the irrigators.	Artesian wells.
California	4,500,000	3,550,000	3,500
Wyoming	3,031,484	185,000	6
Colorado	3,007,050	1,800,000	4,500
Montana	1,250,000	419,000	36
Idaho	1,200,000	330,000	12
Kansas (west of 97°)	990,000	120,000	50
Utah	735,000	423,000	2,524
New Mexico	700,000	405,000	10
Arizona	660,000	315,000	42
Texas	350,000	160,000	1,000
Nebraska	200,000	40,000	1,000
Washington	175,000	75,000	10
Nevada	150,900	75,000	76
Oregon	125,000	45,000	6
South Dakota	100,000	54,000	960
North Dakota	2,500	2,000	670
Total	17,177,843	7,998,000	13,492

Some of the artesian wells are of enormous size, and yield four and five million gallons of water daily, capable of irrigating a section of land. The greater number are small, however, and probably not capable of irrigating more than five or ten acres. Half a million acres is the utmost limit of the present wells. Some artesian districts contain at least that acreage, so that, if the water supply is sufficient, a vast area will be reclaimed by this method.

In the above table the most noticeable fact is that less than half the area lying beneath the water ditches, and capable of irrigation, is now cultivated. This is because it takes a number of years to settle the country, break up the soil, and bring it into cultivation. In progressive communities the possible acreage keeps ahead of the demand until the water supply or the land supply is exhausted. Judging the future by the past, and taking into consideration many projected ditch lines, there will be from thirty to thirty-five million acres under some irrigation system by the close of the decade, and the actually cultivated area may be close upon twenty million acres.

California has had a longer and more extensive experience with irrigation than any other division of the arid belt, and immense sums have been wasted in litigation and experiment. The systems now in use in different districts illustrate all the details of the business. All the larger problems connected with irrigation, such as seepage, drainage, reservoirs, alkali deposits, economy in distribution, can be studied in the valleys of California. More particularly one sees private ownership and district ownership in operation side by side, often in the same county.

The Wright irrigation act, passed in 1887, gave a great impetus

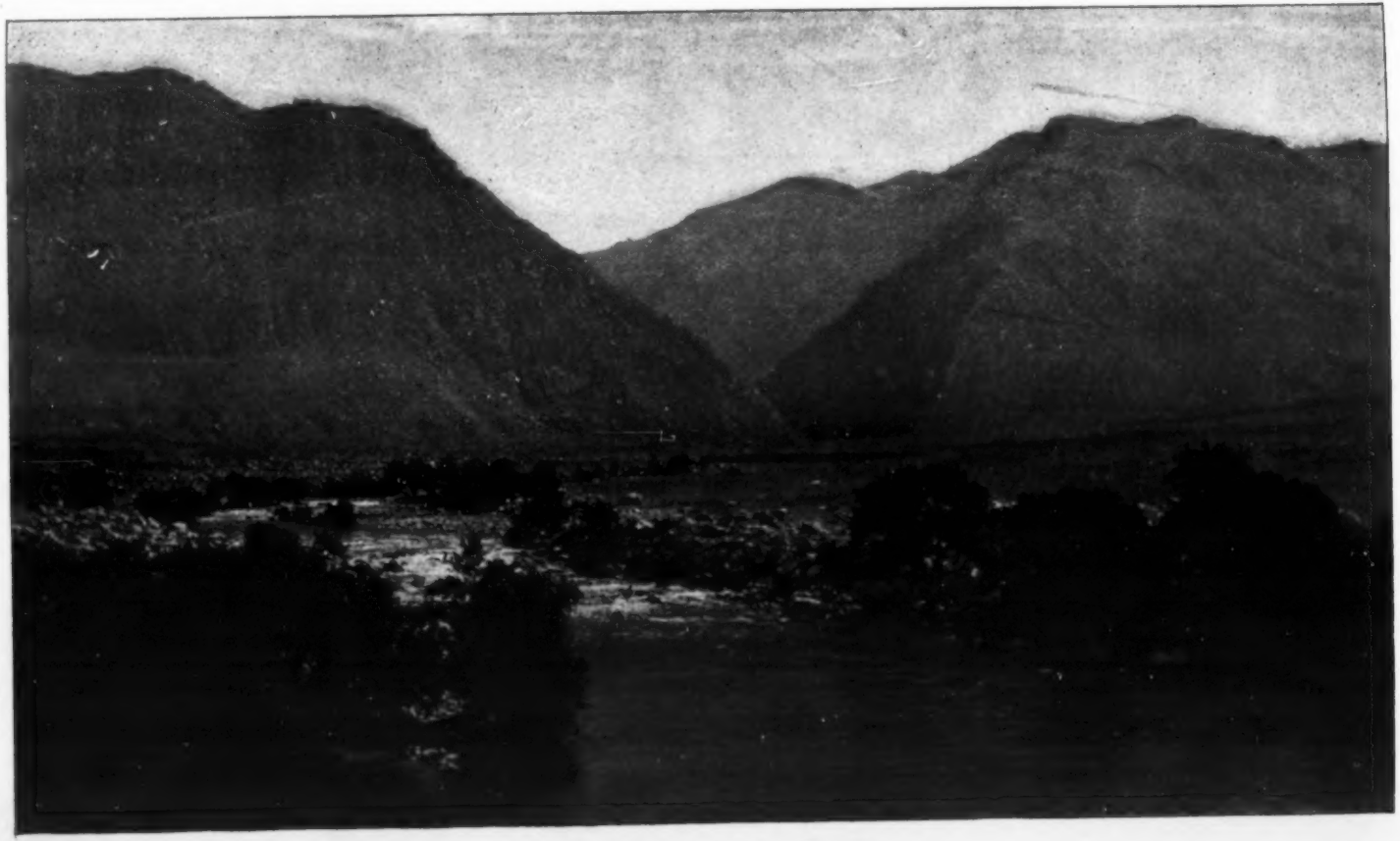

Fig. 2.—Coming out on the Desert.

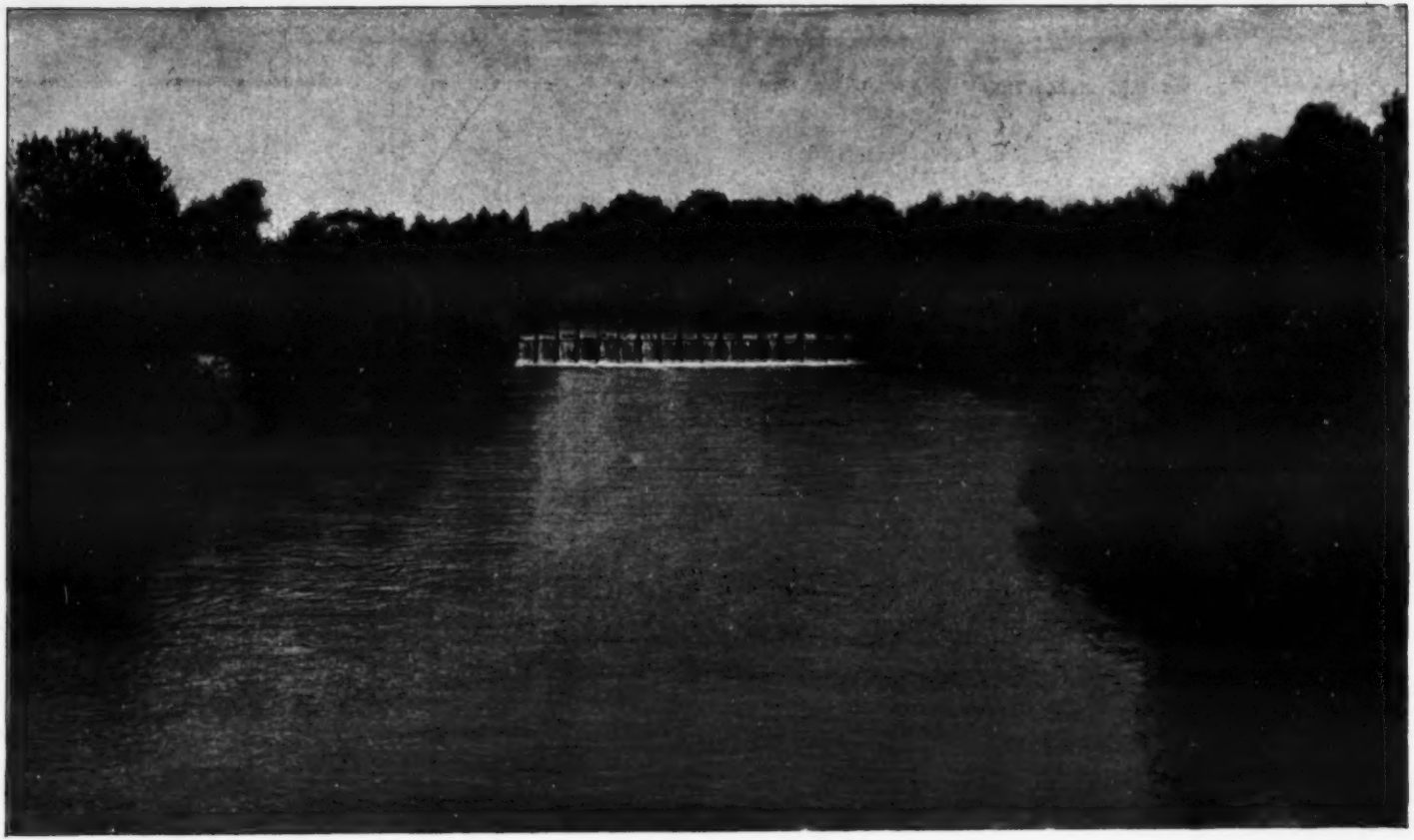

Fig. 4.—The Calloway Canal.

to the process of uniting land and water in a permanent union. No less than thirty-eight districts have been organized already, and they include a total of about two and a half million acres, upon which bonds to the extent of twelve million dollars have been voted. About three million dollars in bonds have been actually issued and sold; seven districts have some of their ditches constructed and full of water; one has completed its entire irrigation system and is in successful operation. It will take a considerable time to obtain the desired capital and complete all the districts organized. Some of them are very large, and will greatly add to the irrigated area. The following table shows the acreage and estimated cost of water supply in the ten largest districts:

Irrigation Districts.

NAME.	Acreage.	Estimated cost.
Sunset	363,000	$2,000,000
Madera	308,000	850,000
Selma	271,000	1,000,000
Turlock	176,000	1,200,000
Central	156,000	750,000
Alta	129,000	675,000
Colusa	100,000	600,000
Kern and Tulare	84,000	700,000
Modesto	80,000	1,400,000
Palmdale	150,000	175,000
Total	1,717,000	$9,350,000

The bulk of the district acreage is included in these ten districts, nine of which are situated in the San Joaquin and Sacramento Valleys. The lowest estimate of cost in any of the thirty-eight districts is $2.56 per acre, and the highest is $83. The last is in the famous orange colony of Riverside, where the water is piped to the land, and where the science of irrigation is perhaps better understood than in any other colony in America. The average first cost of water per acre is a little over eight dollars. Bonds issued are a lien upon all the real estate within the boundaries of the district, as well as upon the irrigation system itself, and are considered by conservative bankers as excellent security.

Beyond doubt the irrigation district laws of California are full of suggestion for cheap and effective work by the land-owners themselves. They are best adapted to communities that have learned something of the value of irrigation and can work together. There are many places where no irrigation will be done until the Government or some private corporation takes hold with the required skill and capital to secure the water and distribute it to the land; then the scattered settlers will use it, and others will come in and buy the land and water. Some of the irrigation dis-

Fig. 5.—One of the Branch Canals.

FIG. 5.—GRAPES FROM THE DESERT.

tricts already organized are meeting with bitter opposition from large land-owners who do not wish to sell, nor to pay higher taxes upon more valuable because more fruitful land. The average farmer with his hundred or five hundred acres, where crops fail one year in three or two in five, is compelled to have water or become bankrupt. The owner of fifty or a hundred thousand acres pastures cattle there and makes a living that suits him. If the small farmers form an irrigation district, the cattle baron is apt to fight it on general principles, and if they outvote him and include any of his land in the taxable area, he fights them to the end. Several of the most promising district ditches of California are lying unfinished at the present time because of the stubborn opposition of the large land-owners, some of them living in Europe.

Private ownership of irrigation canals exists more or less in every county of California. It is too soon to decide the comparative cost of water under the two systems, but the logic of the situation requires supervision of private enterprises by either the State or the General Government. The danger in many private schemes is the sale of more water than can be supplied in seasons of drought, and the consequent loss of crops planted in the expectation of receiving an abundance. There is a golden mean between this extreme and the other, now less frequent than formerly, of claiming ten times as much water as can be used and allowing it to go to waste. One of the greatest corporate irrigation enterprises in the United States is in Merced County. The late Charles Crocker, of San Francisco, was the leading stockholder. Three and a half million dollars has now been spent upon a fifty-mile canal from the Merced River, with a hundred and fifty miles of lesser ditches; a giant reservoir, Lake Yosemite, covering a square mile thirty feet deep, and the purchase of large tracts of land. The company now has water to irrigate six hundred thousand acres. The carrying capacity of the main canal is not less than four thousand cubic feet per second. Colonies are springing up along the line of the canal, and thousands of acres have been planted to crops that justify irrigation.

A still better illustration of what private enterprise has done in this field is shown in the Kern region. Seven hundred miles of large irrigating ditches have been dug in this imperial county, which contains more than five million acres. The annual rainfall is from three to five inches, so that irrigation is absolutely necessary. Thirty large canals have been taken out of Kern River, which rises in the highest part of the Sierra Nevada Mountains. The most famous of these canals is the Calloway, eighty feet wide on the bottom and one hundred and twenty feet wide at the top, seven feet in depth, and usually full to within a few

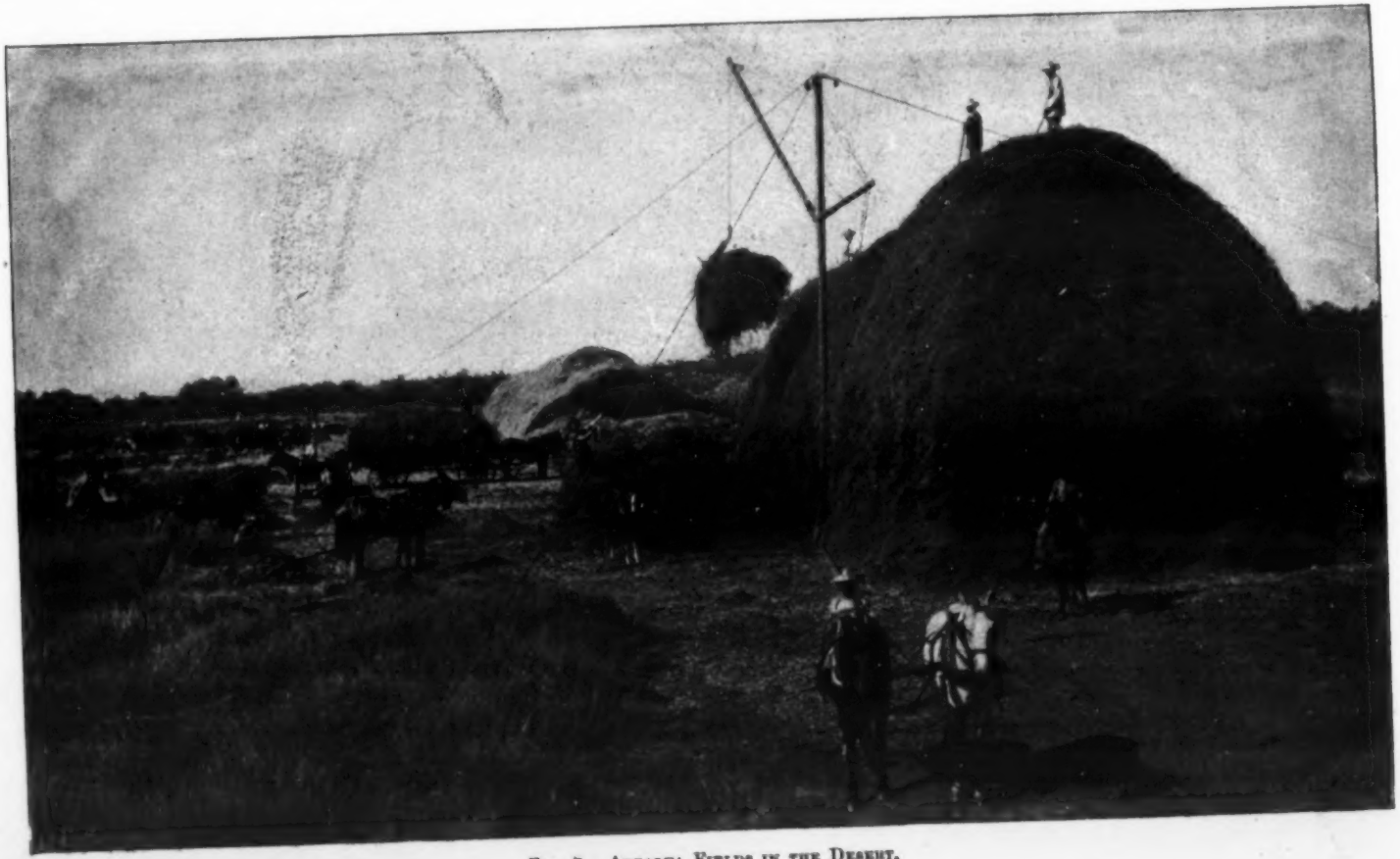

FIG. 7.—ALFALFA FIELDS IN THE DESERT.

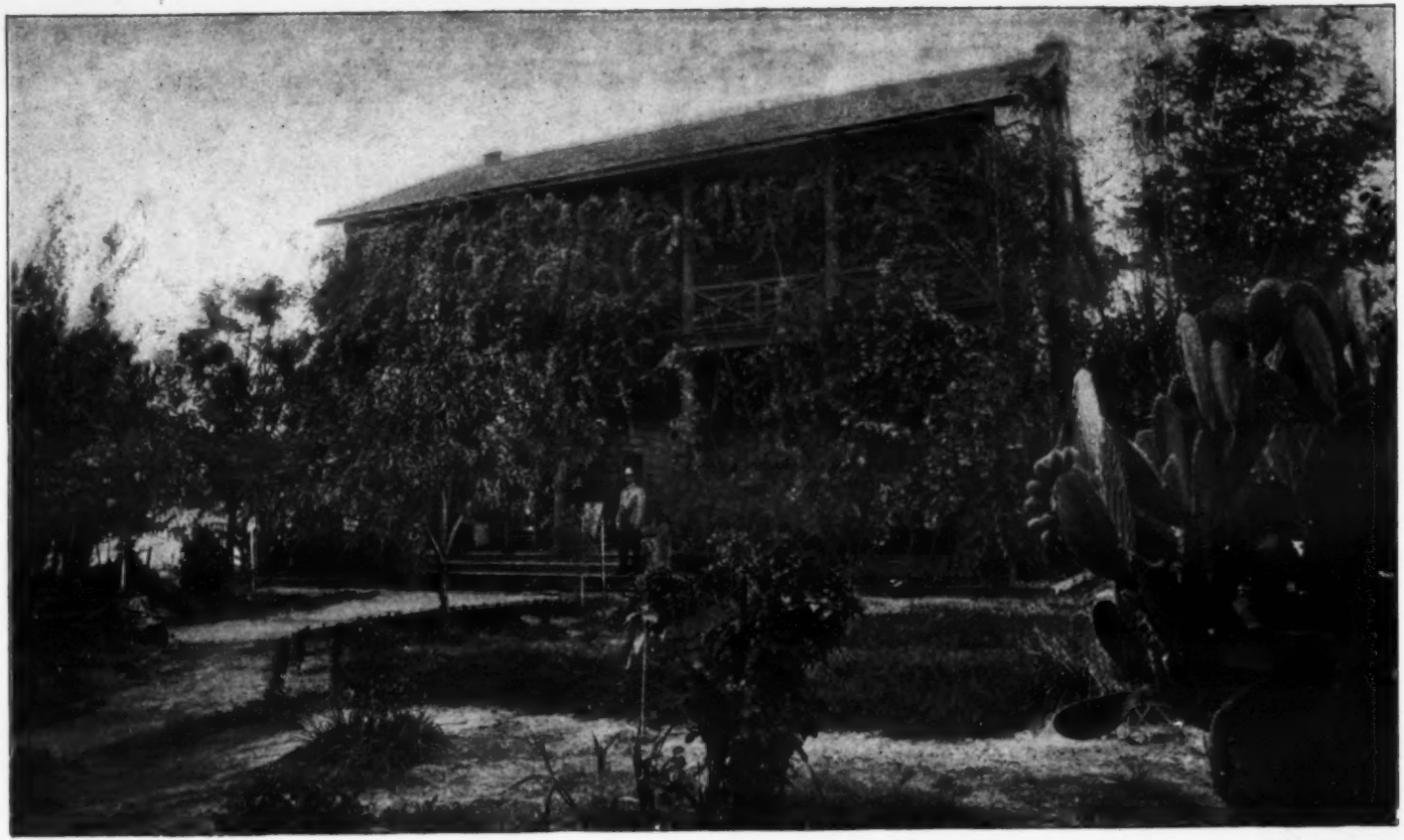

FIG. 8.—AFTER TEN YEARS' IRRIGATION ON A BARREN SAND PLAIN.

inches of the top of the bank. It irrigates two hundred thousand acres through sixty-five laterals, of an aggregate length of one hundred and fifty miles.

But the glory of Kern is the enormous irrigation system upon the Kern Delta, constructed by two San Francisco capitalists—Lloyd Tevis and J. B. Haggin. All in all, it is the largest enterprise of the kind of which I have any knowledge. The total expenditure has been fully four million dollars. For this the owners have obtained a system of twenty-seven main canals with an aggregate length of three hundred miles, besides about eleven hundred miles of permanent laterals. Six hundred thousand acres can be watered from these artificial rivers. The sandy plain slopes south and west upon a grade of five or six feet to the mile. Very little of the land requires leveling. The great reservoir, a former lake basin, covers twenty-five thousand acres and contains fifty billion gallons of water. The various canals of this company and others take from Kern River alone a total of twelve thousand cubic feet of water per second.

Twenty years ago the value of such land was less than a dollar an acre. No settler could live on a quarter section, and like Fresno, Tulare, and in fact most of the San Joaquin Valley, it was used only for pasturage. To-day there are fields of hundreds of acres of alfalfa, where the best of Jerseys and Holsteins are kept; there are orchards of peaches, apricots, prunes, and almonds—thousands of acres—loaded each year with fruit; cotton, sugar beets, the sugar cane of Louisiana, tobacco, corn, cassava, and a multitude of the products of the temperate and semitropic regions thrive here and can be grown as staple crops.

Irrigation is often supposed to belong only to the arid lands. There, it is true, it produces the most surprising changes and the greatest proportionate increase of values. Water poured upon a rainless desert makes it blossom under the tropic sun as if some magician's wand had been waved over it. Vines, fruits, flowers, green lawns, golden wheat, and silver barley, for miles on miles, all lifted by the sparkling rivers above the fluctuations of the season—such are the changes the irrigator brings to the desert. But thousands of valleys and hillsides in the arid regions have enough rainfall to enable farmers to struggle along, and not enough to make their crops a certainty every year. Here there is an even more immediate need of water to supplement the natural supply. No available statistics can illustrate the extent to which pioneers in the Rockies, Sierras, and Coast Range are developing cheaply and easily a local supply of water for their ranches. The last census, which says there are about thirteen thousand irrigators in California (there are really twice as many), is very incomplete in this direction. Besides the organ-

Fig. 9.—An Artesian Well in the Desert.

ized districts and the great irrigation corporations, there are illustrations in thousands of beautiful and fertile valleys, and upon many a sunny hillside, that it pays to irrigate.

In the old placer-mining regions of California one sees much of the local use of water, ranch by ranch, spring by spring, cheaply, easily, and effectually. The miners have long been familiar with the management of water. They built hundreds of miles of hydraulic mining ditches, triumphs of engineering skill, bringing whole rivers from the snow peaks to the beds of gold-bearing gravel below. They siphoned streams over mountains; they belted their flumes in mid-air to perpendicular cliffs of granite a thousand feet from base to crest; they changed little Alpine valleys into mountain lakes. Such men as these find it only child's play to water their hillside gardens, to wall up the "flats" by mountain streams and flood them so that the white clover or alfalfa keeps green there all the year. Thus one finds oases of verdure and fruitfulness about the cottage houses of thousands of mountaineers in Shasta, Trinity, Butte, Lassen, El Dorado, and the whole Sierra range of mining counties south of "Old Tuolumne." Such men as these live in all the mountain ranges of the western half of the continent, and not the least attractive chapter of the story of irrigation is that which tells of their home acres. Even where the annual rainfall is more than sufficient for the ordinary field crops and the deciduous fruits to thrive without irrigation, the dry air and sunlight of the semi-tropic summers often make the application of water desirable for specialized horticulture, or for the greatest obtainable profit from ordinary crops.

Here, then, are the primary schools of the irrigator in the thousands of hidden valleys of Idaho, Dakota, Utah, Colorado, Nevada, and California. Out of them, upon the wide valley plains, upon the vast distances of the high desert mesa lands, the young men of the coming generation of irrigation adepts pass on to greater victories. Artesian fountains spring up along their paths; rivers from regions of mountains, of forests and abundant rainfall, follow in their footsteps; they lead these rivers into the desert and plant gardens there—the grape, the olive, the date palm, the orange, the lemon, the banana, the pomegranate.

The facts and figures which I have used to show the progress of the States and Territories of the arid region are crowded with infinite suggestions and possibilities. Some time, it is not improbable, men may speak of the overflowing granaries, the unparalleled horticultural wealth along the Rio Grande, the Colorado, the Sacramento, the San Joaquin, and other great river plains, as history speaks of Egypt and Assyria in their splendid prime. What are the duties of the American people toward irri-

FIG. 9.—AN ARTESIAN WELL IN THE DESERT.

gation in these all-important years of the beginnings of new commonwealths based upon new industries? Millions of acres of land are forever worthless without water. Who shall own the streams and reservoirs—a few far-sighted men, or the people themselves? Irrigation journals and conventions of irrigators discuss the matter from the standpoint of the present, and endeavor to shape legislation to profitable ends. The slow, dumb masses have not yet recognized the magnitude of the problems involved. An effort is being made to have the United States give all the arid lands to the several States and Territories in which they lie, but the plan is dangerous. Only the Federal Government can protect the sources of water supply; utilize, reservoir, and distribute that supply, and unite water and land in an indissoluble marriage bond.

THE INADEQUACY OF "NATURAL SELECTION."

By HERBERT SPENCER.

[*Concluded.*]

THIS very pronounced opinion will be met on the part of some by a no less pronounced demurrer, which involves a denial of possibility. It has been of late asserted, and by many believed, that inheritance of acquired characters can not occur. Weismann, they say, has shown that there is early established in the evolution of each organism, such a distinctness between those component units which carry on the individual life and those which are devoted to maintenance of the species, that changes in the one can not affect the other. We will look closely into his doctrine.

Basing his argument on the principle of the physiological division of labor, and assuming that the primary division of labor is that between such part of an organism as carries on individual life and such part as is reserved for the production of other lives, Weismann, starting with "the first multicellular organism," says that—"Hence the single group would come to be divided into two groups of cells, which may be called somatic and reproductive—the cells of the body as opposed to those which are concerned with reproduction" (Essays upon Heredity, p. 27).

Though he admits that this differentiation "was not at first absolute, and indeed is not always so to-day," yet he holds that the differentiation eventually becomes absolute in the sense that the somatic cells, or those which compose the body at large, come to have only a limited power of cell-division, instead of an unlimited power which the reproductive cells have; and also in the

sense that eventually there ceases to be any communication between the two, further than that implied by the supplying of nutriment to the reproductive cells by the somatic cells. The outcome of this argument is that, in the absence of communication, changes induced in the somatic cells, constituting the individual, can not influence the natures of the reproductive cells, and can not therefore be transmitted to posterity. Such is the theory. Now let us look at a few facts—some familiar, some unfamiliar.

His investigations led Pasteur to the positive conclusion that the silkworm diseases are inherited. The transmission from parent to offspring resulted, not through any contamination of the surface of the egg by the body of the parent while being deposited, but resulted from infection of the egg itself—intrusion of the parasitic organism. Generalized observations concerning the disease called *pébrine* enabled him to decide by inspection of the eggs which were infected and which were not: certain modifications of form distinguishing the diseased ones. More than this, the infection was proved by microscopical examination of the contents of the egg; in proof of which he quotes as follows from Dr. Carlo Vittadini:

"Il résulte de mes recherches sur les graines, à l'époque où commence le développement du germe, que les corpuscles, une fois apparus dans l'œuf, augmentent graduellement en nombre, à mesure que l'embryon se développe; que, dans les derniers jours de l'incubation, l'œuf en est plein, au point de faire croire que la majeure partie des granules du jaune se sont transformés en corpuscules.

"Une autre observation importante est que l'embryon aussi est souillé de corpuscules, et à un degré tel qu'on peut soupçonner que l'infection du jaune tire son origine du germe lui-même; en d'autres termes que le germe est primordialement infecté, et porte en lui-même ces corpuscules tout comme les vers adultes, frappés du même mal."*

Thus, then, the substance of the egg, and even its innermost vital part, is permeable by a parasite sufficiently large to be microscopically visible. It is also of course permeable by the invisible molecules of protein, out of which its living tissues are formed, and by absorption of which they subsequently grow. But, according to Weismann, it is not permeable by those invisible units of protoplasm out of which the vitally active tissues of the parent are constituted: units composed, as we must assume, of variously arranged molecules of protein. So that the big thing may pass, and the little thing may pass, but the intermediate thing may not pass!

A fact of kindred nature, unhappily more familiar, may be next brought in evidence. It concerns the transmission of a disease not unfrequent among those of unregulated lives. The high-

* Les Maladies des Vers à Soie, par L. Pasteur, i, 39.

est authority concerning this disease, in its inherited form, is Mr. Jonathan Hutchinson; and the following are extracts from a letter I have received from him, and which I publish with his assent:

"I do not think that there can be any reasonable doubt that a very large majority of those who suffer from inherited syphilis take the taint from the male parent. . . . It is the rule when a man marries who has no remaining local lesion, but in whom the taint is not eradicated, for his wife to remain apparently well, while her child may suffer. No doubt the child infects its mother's blood, but this does not usually evoke any obvious symptoms of syphilis. . . . I am sure I have seen hundreds of syphilitic infants whose mothers had not, so far as I could ascertain, ever displayed a single symptom."

See, then, to what we are committed if we accept Weismann's hypothesis. We must conclude that, whereas the reproductive cell may be effectually invaded by an abnormal living element in the parental organism, those normal living elements which constitute the vital protoplasm of the parental organism, can not evade it. Or if it be admitted that both intrude, then the implication is that, whereas the abnormal element can so modify the development as to cause changes of structure (as of the teeth), the normal element can cause no changes of structure!*

We pass now to evidence not much known in the world at large, but widely known in the biological world, though known in so incomplete a manner as to be undervalued in it. Indeed, when I name it probably many will vent a mental pooh-pooh. The fact to which I refer is one of which record is preserved in the museum of the College of Surgeons, in the shape of paintings of a foal borne by a mare not quite thoroughbred, to a sire which was thoroughbred—a foal which bears the markings of the quagga. The history of this remarkable foal is given by the Earl of Morton, F. R. S., in a letter to the President of the Royal Society (read November 23, 1820). In it he states that wishing to domes-

* Curiously enough, Weismann refers to, and recognizes, syphilitic infection of the reproductive cells. Dealing with Brown-Séquard's cases of inherited epilepsy (concerning which, let me say, that I do not commit myself to any derived conclusions), he says: "In the case of epilepsy, at any rate, it is easy to imagine [many of Weismann's arguments are based on things 'it is easy to imagine'] that the passage of some specific organism through the reproductive cells may take place, as in the case of syphilis" (p. 82). Here is a sample of his reasoning. It is well known that epilepsy is frequently caused by some peripheral irritation (even by the lodging of a small foreign body under the skin), and that, among peripheral irritations causing it, imperfect healing is one. Yet though, in Brown-Séquard's cases, a peripheral irritation caused in the parent by local injury was the apparent origin, Weismann chooses gratuitously to assume that the progeny were infected by "some specific organism," which produced the epilepsy! And then, though the epileptic virus, like the syphilitic virus, makes itself at home in the egg, the parental protoplasm is not admitted!

ticate the quagga, and having obtained a male, but not a female, he made an experiment.

"I tried to breed from the male quagga and a young chestnut mare of seven-eighths Arabian blood, and which had never been bred from; the result was the production of a female hybrid, now five years old, and bearing, both in her form and in her color, very decided indications of her mixed origin. I subsequently parted with the seven-eighths Arabian mare to Sir Gore Ouseley, who has bred from her by a very fine black Arabian horse. I yesterday morning examined the produce, namely, a two-year-old filly and a year-old colt. They have the character of the Arabian breed as decidedly as can be expected, where fifteen-sixteenths of the blood are Arabian; and they are fine specimens of that breed; but both in their color and in the hair of their manes, they have a striking resemblance to the quagga. Their color is bay, marked more or less like the quagga in a darker tint. Both are distinguished by the dark line along the ridge of the back, the dark stripes across the fore-hand, and the dark bars across the back part of the legs."*

Lord Morton then names sundry further correspondences. Dr. Wollaston, at that time President of the Royal Society, who had seen the animals, testified to the correctness of his description, and, as shown by his remarks, entertained no doubt about the alleged facts. But good reason for doubt may be assigned. There naturally arises the question—How does it happen that parallel results are not observed in other cases? If in any progeny certain traits not belonging to the sire, but belonging to a sire of preceding progeny, are reproduced, how is it that such anomalously-inherited traits are not observed in domestic animals, and indeed in mankind? How is it that the children of a widow by a second husband do not bear traceable resemblances of the first husband? To these questions nothing like satisfactory replies seem forthcoming; and, in the absence of replies, skepticism, if not disbelief, may be held reasonable.

There is an explanation, however. Forty years ago I made acquaintance with a fact which impressed me by its significant implications; and has for this reason, I suppose, remained in my memory. It is set forth in the Journal of the Royal Agricultural Society, vol. xiv (1853), pp. 214 *et seq.*, and concerns certain results of crossing English and French breeds of sheep. The writer of the translated paper, M. Malingié-Nouel, Director of the Agricultural School of La Charmoise, states that when the French breeds of sheep (in which were included "the *mongrel* Merinos") were crossed with an English breed, "the lambs present the following results. Most of them resemble the mother more than the father; some show no trace of the father." Joining the admission respecting the mongrels with the facts subsequently stated, it is tolerably clear that the cases in which the lambs bore no

* Philosophical Transactions of the Royal Society for the Year 1821, Part I, pp. 20–24.

traces of the father were cases in which the mother was of pure breed. Speaking of the results of these crossings in the second generation "having 75 per cent of English blood," M. Nouel says: "The lambs thrive, wear a beautiful appearance, and complete the joy of the breeder. . . . No sooner are the lambs weaned than their strength, their vigor, and their beauty begin to decay. . . . At last the constitution gives way. . . . he remains stunted for life," the constitution being thus proved unstable or unadapted to the requirements. How, then, did M. Nouel succeed in obtaining a desirable combination of a fine English breed with the relatively poor French breeds?

"He took an animal from 'flocks originally sprung from a mixture of the two distinct races that are established in these two provinces [Berry and La Sologne],' and these he 'united with animals of another mixed breed. . . . which blended the Tourangelle and native Merino blood of' La Beauce and Touraine, and obtained a mixture of all four races 'without decided character, without fixity. . . . but possessing the advantage of being used to our climate and management.'

"Putting one of these 'mixed-blood ewes to a pure New-Kent ram. . . . one obtains a lamb containing fifty-hundredths of the purest and most ancient English blood, with twelve and a half hundredths of four different French races, which are individually lost in the preponderance of English blood, and disappear almost entirely, leaving the improving type in the ascendant. . . . All the lambs produced strikingly resembled each other, and even Englishmen took them for animals of their own country.'"

M. Nouel goes on to remark that when this derived breed was bred with itself, the marks of the French breeds were lost. "Some slight traces could be detected by experts, but these soon disappeared."

Thus, we get proof that relatively pure constitutions predominate in progeny over much mixed constitutions. The reason is not difficult to see. Every organism tends to become adapted to its conditions of life; and all the structures of a species, accustomed through multitudinous generations to the climate, food, and various influences of its locality, are molded into harmonious co-operation favorable to life in that locality: the result being that in the development of each young individual, the tendencies conspire to produce the fit organization. It is otherwise when the species is removed to a habitat of different character, or when it is of mixed breed. In the one case its organs, partially out of harmony with the requirements of its new life, become partially out of harmony with one another; since, while one influence, say of climate, is but little changed, another influence, say of food, is much changed; and consequently, the perturbed relations of the organs interfere with their original stable equilibrium. Still more in the other case is there a disturbance of equilibrium. In a mongrel the constitution derived from each

source repeats itself as far as possible. Hence a conflict of tendencies to evolve two structures more or less unlike. The tendencies do not harmoniously conspire; but produce partially incongruous sets of organs. And evidently where the breed is one in which there are united the traits of various lines of ancestry, there results an organization so full of small incongruities of structure and action, that it has a much-diminished power of maintaining its balance; and while it can not withstand so well adverse influences, it can not so well hold its own in the offspring. Concerning parents of pure and mixed breeds respectively, severally tending to reproduce their own structures in progeny, we may, therefore, say figuratively that the house divided against itself can not withstand the house, of which the members are in concord.

Now if this is shown to be the case with breeds the purest of which have been adapted to their habitats and modes of life during some few hundred years only, what shall we say when the question is of a breed which has had a constant mode of life in the same locality for ten thousand years or more, like the quagga? In this the stability of constitution must be such as no domestic animal can approach. Relatively stable as may have been the constitutions of Lord Morton's horses, as compared with the constitutions of ordinary horses, yet, since Arab horses, even in their native country, have probably in the course of successive conquests and migrations of tribes become more or less mixed, and since they have been subject to the conditions of domestic life, differing much from the conditions of their original wild life, and since the English breed has undergone the perturbing effects of change from the climate and food of the East to the climate and food of the West, the organizations of the horse and mare in question could have had nothing like that perfect balance produced in the quagga by a hundred centuries of harmonious co-operation. Hence the result. And hence at the same time the interpretation of the fact that analogous phenomena are not perceived among domestic animals, or among ourselves; since both have relatively mixed, and generally extremely mixed, constitutions, which, as we see in ourselves, have been made generation after generation, not by the formation of a mean between two parents, but by the jumbling of traits of the one with traits of the other, until there exist no such conspiring tendencies among the parts as cause repetition of combined details of structure in posterity.

Expectation that skepticism might be felt respecting this alleged anomaly presented by the quagga-marked foal, had led me to think over the matter; and I had reached this interpretation before sending to the College of Surgeons Museum (being unable to go myself) to obtain the particulars and refer to the records.

When there was brought to me a copy of the account as set forth in the Philosophical Transactions, it was joined with the information that there existed an appended account of pigs, in which a parallel fact had been observed. To my immediate inquiry—"Was the male a wild pig?"—there came the reply: "I did not observe." Of course I forthwith obtained the volume, and there found what I expected. It was contained in a paper communicated by Dr. Wollaston from Daniel Giles, Esq., concerning his "sow and her produce," which said that

"she was one of a well-known black and white breed of Mr. Western, the Member for Essex. About ten years since I put her to a boar of the wild breed, and of a deep chestnut color, which I had just received from Hatfield House, and which was soon afterward drowned by accident. The pigs produced (which were her first litter) partook in appearance of both boar and sow, but in some the chestnut color of the boar strongly prevailed.

"The sow was afterward put to a boar of Mr. Western's breed (the wild boar having been long dead). The produce was a litter of pigs, some of which, we observed with much surprise, to be stained and clearly marked with the chestnut color which had prevailed in the former litter."

Mr. Giles adds that in a second litter of pigs, the father of which was of Mr. Western's breed, he and his bailiff believe there was a recurrence, in some, of the chestnut color, but admits that their "recollection is much less perfect than I wish it to be." He also adds that, in the course of many years' experience, he had never known the least appearance of the chestnut color in Mr. Western's breed.

What are the probabilities that these two anomalous results should have arisen, under these exceptional conditions, as a matter of chance? Evidently the probabilities against such a coincidence are enormous. The testimony is in both cases so good that, even apart from the coincidence, it would be unreasonable to reject it; but the coincidence makes acceptance of it imperative. There is mutual verification, at the same time that there is a joint interpretation yielded of the strange phenomenon, and of its non-occurrence under ordinary circumstances.

And now, in the presence of these facts, what are we to say? Simply that they are fatal to Weismann's hypothesis. They show that there is none of the alleged independence of the reproductive cells; but that the two sets of cells are in close communion. They prove that while the reproductive cells multiply and arrange themselves during the evolution of the embryo, some of their germ-plasm passes into the mass of somatic cells constituting the parental body, and becomes a permanent component of it. Further, they necessitate the inference that this introduced germ-plasm, everywhere diffused, is some of it included in the reproductive cells subsequently formed. And if we thus get a demon-

stration that the somewhat different units of a foreign germ-plasm permeating the organism, permeate also the subsequently-formed reproductive cells, and affect the structures of the individuals arising from them, the implication is that the like happens with those native units which have been made somewhat different by modified functions: there must be a tendency to inheritance of acquired characters.

One more step only has to be taken. It remains to ask what is the flaw in the assumption with which Weismann's theory sets out. If, as we see, the conclusions drawn from it do not correspond to the facts, then, either the reasoning is invalid, or the original postulate is untrue. Leaving aside all questions concerning the reasoning, it will suffice here to show the untruth of the postulate. Had his work been written during the early years of the cell-doctrine, the supposition that the multiplying cells of which the Metazoa and the Metaphyta are composed, become completely separate, could not have been met by a reasonable skepticism; but now, not only is skepticism justifiable, but denial is called for. Some dozen years ago it was discovered that in many cases vegetal cells are connected with one another by threads of protoplasm—threads which unite the internal protoplasm of one cell with the internal protoplasms of cells around. It is as though the pseudopodia of imprisoned rhizopods were fused with the pseudopodia of adjacent imprisoned rhizopods. We can not reasonably suppose that the continuous network of protoplasm thus constituted has been produced after the cells have become adult. These protoplasmic connections must have survived the process of fission. The implication is that the cells forming the embryo-plant retained their protoplasmic connections while they multiplied, and that such connections continued throughout all subsequent multiplications—an implication which has, I believe, been established by researches upon germinating palm-seeds. But now we come to a verifying series of facts which the cell-structures of animals in their early stages present. In his Monograph of the Development of Peripatus Capensis, Mr. Adam Sedgwick, F.R.S., Reader in Animal Morphology at Cambridge, writes as follows:—

"All the cells of the ovum, ectodermal as well as endodermal, are connected together by a fine protoplasmic reticulum" (p. 41).

"The continuity of the various cells of the segmenting ovum is primary, and not secondary; i. e., in the cleavage the segments do not completely separate from one another. But are we justified in speaking of cells at all in this case? *The fully segmented ovum is a syncytium, and there are not and have not been at any stage cell limits*" (p. 41).

"It is becoming more and more clear every day that the cells composing the tissues of animals are not isolated units, but that they are connected with one

another. I need only refer to the connection known to exist between connective-tissue cells, cartilage cells, epithelial cells, etc. And not only may the cells of one tissue be continuous with each other, but they may also be continuous with the cells of other tissues" (pp. 47, 48).

"Finally, if the protoplasm of the body is primitively a syncytium, and the ovum until maturity a part of that syncytium, the separation of the generative products does not differ essentially from the internal gemmation of a Protozoon, and the inheritance by the offspring of peculiarities first appearing in the parent, though not explained, is rendered less mysterious; for the protoplasm of the whole body being continuous, change in the molecular constitution of any part of it would naturally be expected to spread, in time, through the whole mass" (p. 49).

Mr. Sedgwick's subsequent investigations confirm these conclusions. In a letter of December 27, 1892, passages, which he allows me to publish, run as follows:

"All the embryological studies that I have made since that to which you refer confirm me more and more in the view that the connections between the cells of adults are not secondary connections, but primary, dating from the time when the embryo was a unicellular structure. . . . My own investigations on this subject have been confined to the Arthropoda, Elasmobranchii, and Aves. I have thoroughly examined the development of at least one kind of each of these groups, and I have never been able to detect a stage in which the cells were not continuous with each other; and I have studied innumerable stages from the beginning of cleavage onward."

So that the alleged independence of the reproductive cells does not exist. The *soma*—to use Weismann's name for the aggregate of cells forming the body—is, in the words of Mr. Sedgwick, "a continuous mass of vacuolated protoplasm"; and the reproductive cells are nothing more than portions of it separated some little time before they are required to perform their functions.

Thus the theory of Weismann is doubly disproved. Inductively we are shown that there *does* take place that communication of characters from the somatic cells to the reproductive cells, which he says can not take place; and deductively we are shown that this communication is a natural sequence of connections between the two which he ignores: his various conclusions are deduced from a postulate which is untrue.

From the title of this essay, and from much of its contents, nine readers out of ten will infer that it is directed against the views of Mr. Darwin. They will be astonished on being told that, contrariwise, it is directed against the views of those who, in a considerable measure, dissent from Mr. Darwin. For the inheritance of acquired characters, which it is now the fashion in the biological world to deny, was, by Mr. Darwin, fully recognized and often insisted on. Such of the foregoing arguments as touch Mr. Darwin's views, simply imply that the cause of evolution which at first he thought unimportant, but the importance of

which he increasingly perceived as he grew older, is more important than he admitted even at the last. The neo-Darwinists, however, do not admit this cause at all.

Let it not be supposed that this explanation implies any disapproval of the dissentients, considered as such. Seeing how little regard for authority I have myself usually shown, it would be absurd in me to reflect in any degree upon those who have rejected certain of Mr. Darwin's teachings, for reasons which they have thought sufficient. But while their independence of thought is to be applauded rather than blamed, it is, I think, to be regretted that they have not guarded themselves against a long-standing bias. It is a common trait of human nature to seek some excuse when found in the wrong. Invaded self-esteem sets up a defense, and anything is made to serve. Thus it happened that when geologists and biologists, previously holding that all kinds of organisms arose by special creations, surrendered to the battery opened upon them by The Origin of Species, they sought to minimize their irrationality by pointing to irrationality on the other side. "Well, at any rate, Lamarck was in the wrong." "It is clear that we were right in rejecting his doctrine." And so, by duly emphasizing the fact that he overlooked "Natural Selection" as the chief cause, and by showing how erroneous were some of his interpretations, they succeeded in mitigating the sense of their own error. It is true their creed was that at successive periods in the Earth's history, old Floras and Faunas had been abolished and others introduced; just as though, to use Prof. Huxley's figure, the table had been now and again kicked over and a new pack of cards brought out. And it is true that Lamarck, while he rejected this absurd creed, assigned for the facts reasons some of which are absurd. But in consequence of the feeling described, his defensible belief was forgotten and only his indefensible ones remembered. This one-sided estimate has become traditional; so that there is now often shown a subdued contempt for those who suppose that there can be any truth in the conclusions of a man whose general conception was partly sense, at a time when the general conceptions of his contemporaries were wholly nonsense. Hence results unfair treatment—hence result the different dealings with the views of Lamarck and of Weismann.

"Where are the facts proving the inheritance of acquired characters"? ask those who deny it. Well, in the first place, there might be asked the counter-question—Where are the facts which disprove it? Surely if not only the general structures of organisms, but also many of the modifications arising in them, are inheritable, the natural implication is that all modifications are inheritable; and if any say that the inheritableness is limited

to those arising in a certain way, the *onus* lies on them of proving that those otherwise arising are not inheritable. Leaving this counter-question aside, however, it will suffice if we ask another counter-question. It is asserted that the dwindling of organs from disuse is due to the successive survivals in posterity of individuals in which the organs had varied in the direction of decrease. Where now are the facts supporting this assertion? Not one has been assigned or can be assigned. Not a single case can be named in which *panmixia* is a proved cause of diminution. Even had the deductive argument for *panmixia* been as valid as we have found it to be invalid, there would still have been required, in pursuance of scientific method, some verifying inductive evidence. Yet though not a shred of such evidence has been given, the doctrine is accepted with acclamation, and adopted as part of current biological theory. Articles are written and letters published in which it is assumed that this mere speculation, justified by not a tittle of proof, displaces large conclusions previously drawn. And then, passing into the outer world, this unsupported belief affects opinion there too; so that we have recently had a Right Honorable lecturer who, taking for granted its truth, represents the inheritance of acquired characters as an exploded hypothesis, and thereupon proceeds to give revised views of human affairs.

Finally, there comes the reply that there *are* facts proving the inheritance of acquired characters. All those assigned by Mr. Darwin, together with others such, remain outstanding when we find that the interpretation by *panmixia* is untenable. Indeed, even had that hypothesis been tenable, it would have been inapplicable to these cases; since in domestic animals, artificially fed and often overfed, the supposed advantage from economy can not be shown to tell; and since, in these cases, individuals are not naturally selected during the struggle for life in which certain traits are advantageous, but are artificially selected by man without regard to such traits. Should it be urged that the assigned facts are not numerous, it may be replied that there are no persons whose occupations and amusements incidentally bring out such facts; and that they are probably as numerous as those which would have been available for Mr. Darwin's hypothesis, had there been no breeders and fanciers and gardeners who, in pursuit of their profits and hobbies, furnished him with evidence. It may be added that the required facts are not likely to be numerous, if biologists refuse to seek for them.

See, then, how the case stands. Natural selection, or survival of the fittest, is almost exclusively operative throughout the vegetal world and throughout the lower animal world, characterized by relative passivity. But with the ascent to higher types of

animals, its effects are in increasing degrees involved with those produced by inheritance of acquired characters; until, in animals of complex structures, inheritance of acquired characters becomes an important, if not the chief, cause of evolution. We have seen that natural selection can not work any changes in organisms save such as conduce in considerable degrees, directly or indirectly, to the multiplication of the stirp; whence failure to account for various changes ascribed to it. And we have seen that it yields no explanation of the co-adaptation of co-operative parts, even when the co-operation is relatively simple, and still less when it is complex. On the other hand, we see that if, along with the transmission of generic and specific structures, there tend to be transmitted modifications arising in a certain way, there is a strong *a priori* probability that there tend to be transmitted modifications arising in all ways. We have a number of facts confirming this inference, and showing that acquired characters *are* inherited—as large a number as can be expected, considering the difficulty of observing them and the absence of search. And then to these facts may be added the facts with which this essay set out, concerning the distribution of tactual discriminativeness. While we saw that these are inexplicable by survival of the fittest, we saw that they are clearly explicable as resulting from the inheritance of acquired characters. And here let it be added that this conclusion is conspicuously warranted by one of the methods of inductive logic, known as the method of concomitant variations. For throughout the whole series of gradations in perceptive power, we saw that the amount of the effect is proportionate to the amount of the alleged cause.—*Contemporary Review.*

THE CEREMONIAL USE OF TOBACCO.

By JOHN HAWKINS.

COMPARING the stone age of the New World with that of the Old, an important point of difference comes at once into view. The American race is distinguished in culture from all other savages by the possession and use of an implement to which nothing analogous is found among the prehistoric relics of the Eastern hemisphere. That implement is the tobacco pipe.

Among the aborigines of America the use of tobacco was widely prevalent. The practice of cigar-smoking was observed by the companions of Columbus on his first voyage; and in the brilliant series of discoveries which followed the great admiral's achievement, as well as in the slower process of exploration and colonization, the pipe, the cigar, and the snuff mortar revealed

themselves at every step. Even if written records were wanting, the ancient American smoking implements which enrich the museums of this country and Europe would enable us to assert the general use of tobacco throughout the New World. Combining the written and unwritten records, our information on this point is complete. On the southern continent, although pre-Columbian pipes are occasionally found, smoking was not so extensively practiced as in the north. Still, several varieties of the tobacco plant occur here, and the natives were doubtless well acquainted with its use. Cabral, in 1515, observed in Brazil the practice of chewing tobacco, and on the western coast the abundance of small mortars, carved like the mound pipes of the Mississippi Valley in the shape of various animals, attest the extensive use of tobacco as snuff. Leaving South America and crossing the tenth degree of north latitude, we approach the native land of the pipe. A province of Yucatan is thought by some to have given a name to the tobacco plant. A tubular pipe occurs in the sculptures of Palenque. In Mexico the common custom of smoking was noted by Cortes in 1519, and the truth of his statement is evinced by the quantities of elaborately decorated clay pipes since unearthed in that country, as well as by some of the pictured figures of the ancient manuscripts. Pipes of clay or stone are found in abundance throughout the United States, those from the mounds, sculptured in the form of various quadrupeds and birds, and occasionally of men, being among the most interesting examples of native art. Still farther north the great narcotic had established its sway, prior to the advent of Europeans, beyond the Great Lakes, in the far Northwest, and in the East, where the French gave to a tribe of inordinate smokers the name of Petuns, from *petune*, a native name of the tobacco plant.

The use of tobacco excited in the first Europeans who witnessed it feelings of astonishment and disgust. If Montesquieu is to be believed, the Spanish casuists of the fifteenth century offered to the public conscience, in extenuation of the enslavement of the Indians, the fact, among others, that they smoked tobacco. There is other evidence to show that the early explorers of the New World regarded the custom of smoking as the extremity of barbarism; nor have advocates of this view been lacking from that day to this. But, in spite of all objections, tobacco has extended its reign over the entire earth; it is an important source of revenue to the most enlightened of modern governments; it numbers among its devotees men of all races and of all ranks; it solaces the dreary life of the Eskimo and of the Central African savage; but a little while ago it furnished inspiration to the genius of one of the world's great poets. Concerning the adoption by civilized people of a barbarous custom like that under discussion

much might be said; but leaving this for the present, I desire to call attention to a phase of the subject which has received but little attention, namely, the ceremonial use of tobacco by the natives of America.

Since the world-wide diffusion of the tobacco habit, its earliest, and perhaps original, use has been in a great measure overlooked. With the aborigines of America, smoking and its kindred practices were not mere sensual gratifications, but tobacco was regarded as an herb of peculiar and mysterious sanctity, and its use was deeply and intimately interwoven with native rites and ceremonies. With reasonable certainty the pipe may be considered as an implement the use of which was originally confined to the priest, medicine-man, or sorcerer, in whose hands it was a means of communication between savage man and the unseen spirits with which his universal doctrine of animism invested every object that came under his observation. Similar to this use of the pipe was its employment in the treatment of disease, which in savage philosophy is always thought to be the work of evil spirits. Tobacco was also regarded as an offering of peculiar acceptability to the unknown powers in whose hands the Indian conceived his fate for good or ill to lie; hence it is observed to figure prominently in ceremonies as incense, and as material for sacrifice. It will be my task to collect here some of the many observations of travelers, and of students of Indian custom and belief, which illustrate these remarks.

Embalmed in poetry and frequently described in prose, perhaps the most familiar example of the ceremonial employment of tobacco is the use of the calumet, or peace pipe. In its pungent fumes agreements were made binding, enmity was disarmed. It was at once the implement of Indian diplomacy, the universally recognized emblem of friendship, the flag of truce used in approaching strange or hostile tribes, the seal of solemn compacts. Upon its use was founded the widely diffused calumet dance, a performance reserved for occasions when it was desired to express special friendship. Like many other usages connected with the pipe, the calumet, with the traditions which surround it, have survived to the present day. In many parts of Canada and the western United States the visitor to the Indian villages is still expected to present pipes and tobacco as evidences of amity and good will.

There were other sacred pipes besides the calumet, and these were called into requisition on every possible occasion—in the election of chiefs, in the ceremony of adoption into the tribe, at the beginning of a hunt, on going to war, at the end of the harvest, and in innumerable other acts of Indian life, both public and private, as well as in many dances and festivals. Tobacco, in short, was intimately connected with the entire social and reli-

gious systems of the Americans. References to these minor usages are so abundant in the writings of those who have described the customs and arts of the aborigines, and so familiar to the general reader, that they may be here omitted.

Of more importance are the accounts of the employment of tobacco as sacrifice and incense. Hariot, the historian of Sir Richard Grenville's expedition to Virginia in 1584, after speaking of the cultivation and use by the natives of tobacco, or *uppowoc*, says: "This uppowoc is of so precious estimation among them that they think their gods are marvellously delighted therewith; whereupon they sometimes make hallowed fires, and cast some of the powder therein for a sacrifice. Being in a storme upon the waters, to pacifie their gods they cast some up into the aire, and into the water; so a weare for fish being newly set up, they cast some therein, and into the aire; also after an escape of danger they cast some into the aire likewise; but all done with such strange gestures, stamping, sometimes dancing, clapping of hands, holding up of hands, and staring up into the heavens, uttering therewithal, and chattering strange words and noises." In the narrative of the voyage of Drake, in 1572, it is noted that the natives brought little rush baskets filled with *tabak*, offering them to the whites, as the narrator says, "upon the persuasion that we were gods." The Jesuit missionary Allouez, in 1671, visited the Foxes, in the neighborhood of Green Bay, and after some trouble succeeded in inducing them to listen to his preaching, which was, as Parkman relates, so successful at length that when he showed them his crucifix they would throw tobacco on it as an offering. An early missionary among the Hurons states that they worshiped an *oki*, or spirit, who dwelt in a certain rock, and who could give success to travelers. Into the clefts of the rock they were accustomed to place offerings of tobacco, praying for protection from their enemies and from shipwreck. Early explorers frequently refer to offerings of tobacco found near prominent hills, rocks, and trees, and in the vicinity of dangerous rapids and falls—places, as the poet Moore has it—

> "Where the trembling Indian brings
> Belts of porcelain, pipes, and rings,
> Tributes, to be hung in air,
> To the fiend presiding there."

In the narrative of his captivity among the Indians of Lake Superior John Tanner gives a prayer which he heard recited by the leader of a fleet of canoes upon the lake, asking for a safe voyage. At its conclusion the chief threw tobacco into the water, and the occupants of each canoe followed his example. Coming down to more recent times, the presence of two sacred bowlders

near the famous red pipestone quarry of the Coteau des Prairies is mentioned by Catlin, who says that the Indians never went quite to them, but standing some distance away they would throw plugs of tobacco to them, thus asking permission of the indwelling spirits to dig and remove the precious pipestone.

Still later survivals of the ancient customs connected with the use of tobacco may be noted. According to Colonel Garrick Mallery, an instance of the use of tobacco as incense was furnished by the Iroquois as late as 1882. The following words were addressed to the fire: "Bless thy grandchildren; protect and strengthen them. By this tobacco we give thee a sweet-smelling sacrifice, and ask thy care to keep us from sickness and famine." The Iroquois still make an annual sacrifice of a white dog, on which occasions tobacco is solemnly burned. The idea underlying this employment of tobacco is well shown in the prayer which accompanies the ceremony: "I now cast into the fire the Indian tobacco, that as the scent rises up into the air it may ascend to thy abode of peace and quietness; and thou wilt perceive and know that thy counsels are duly observed by mankind, and wilt recognize and approve the objects for which thy blessing has been asked." Another late custom of the Iroquois is thus related by Mrs. Erminnie A. Smith: "In a dry summer season, the horizon being filled with distant thunderheads, it was customary to burn what the Indians call real tobacco, as an offering to bring rain. . . . Every family was supposed to have a private altar upon which its offerings were secretly made; after which that family must repair, bearing its tithe, to the council house where the gathered tithes of tobacco were burned in the council fire. . . . Burning tobacco is the same as praying. In times of trouble or fear, after a bad dream, or any event which frightens them, they say, 'My mother went out and burned tobacco.'" The Cohuilla Indians of California believe in evil spirits called *sespes*, and when they can not sleep they make offerings to these of tobacco. In making their buffalo medicine the Dakotas were accustomed to burn tobacco to bring the herds. Some American Indians before killing a rattlesnake would make an offering to its spirit by sprinkling a pinch of tobacco on its head. Others would beg pardon of a bear which they had killed, and by placing the peace pipe in its mouth and blowing the smoke down its throat, ask its spirit not to take revenge. The Sioux in Hennepin's time looked toward the sun when they smoked, and when the calumet was lighted they held it aloft, saying, "Smoke, sun." A like custom prevailed among the Creeks. Gordon William Lillie ("Pawnee Bill"), speaking of the pipe dance of the Pawnees, says that "before lighting their pipes they throw a pinch of the tobacco into the air. This, with the first three puffs of smoke, which are

also blown high in the air, goes to the good spirit. The ashes they are very particular to throw to the fire, and this is ill luck to the bad spirit. The pipe (the Indian's idol and shrine) is to the Pawnee what the Bible is to the white man, and goes hand in hand with all the principal dances."

The facts of this paragraph are gleaned from the interesting reports made by Miss Alice C. Fletcher upon her studies of various Indian tribes: At the Uncpapa festival of the white buffalo, a priest must be present to fill the pipe, a ceremony performed with a ritual of words, and it is believed that should the person saying it make a mistake, or omit a word, he would incur death from the sacrilege. Relating the details of this festival for publication, the narrators seated themselves toward the sunrise, lighted the pipe, bowed to the earth, and passed it, uttering a prayer. In the Elk mystery or festival of the Ogallala Sioux the pipe is introduced, together with little bunches of tobacco rolled in cloth. It figures also in the ghost-lodge ceremony of the same Indians. The pipe dance of the Omahas is an elaborate ceremony which can not here be adequately described. It is sometimes exchanged between different gentes of the same tribe, but generally between two tribes. The two "pipes" peculiar to this dance are not pipes at all, but only stems, the pipe-bowls being replaced by the heads of ducks. The stems are hollowed carefully, however, and smoking is sometimes simulated, in which cases the symbolism is as binding as when the fumes are present. The perforation of the stems is made quite large, to prevent clogging, which is regarded as a great calamity. Among the Pawnees, if a stoppage occurs in smoking a peace pipe, the bearer loses his life. Only a man who has proved himself valiant in battle, or wise in council, or who has given away horses, can make one of these pipes. The pipes are wrapped in the skin of a wild cat, and the bearing of this roll is a special office. This ceremony, which is accompanied by an elaborate ritual comprising a number of songs, handed down with their archaic words through many generations, was one of the means in ancient times by which possessions were accumulated and exchanged, and honors counted and received. It seems to symbolize fellowship or kinship. The same dance, with a few minor points of difference, is common to the Omaha, Ponca, Otoe, Pawnee, and Sioux tribes. In their journeys to and fro the dance parties are regarded as peacemakers by all who meet them, because of the presence of the pipes. Should a war party come in sight, the warriors would make a wide detour to avoid the group, even though it belonged to the tribe about to be attacked.

The investigations of the Rev. J. Owen Dorsey among the Omahas also reveal many survivals of ancient ceremonies which illustrate the sacred characteristics pertaining to the pipe. This

tribe possesses but two sacred pipes, which are in the keeping of a certain gens, though seven gentes are said to have once possessed pipes which were reserved for ceremonial usages. The two now in existence are called sacred pipes, or red pipes, and are made of the famous red pipestone. The filling of the pipes is not done by the keepers, but by a man of another gens; and, when this official does not go to the council, the pipes can not be smoked, since no one else can fill them. The ancient ritual for this ceremonial filling of the pipes must not be heard, so he sends all the others out of the lodge. He utters some words when he cleans out the bowl, others when he fills it. The pipes are then lighted by the keeper, and are ready for use. In opening, handling, smoking, and emptying them certain regulations must be carefully observed. Any violation of these laws they believe will be followed by the death of the offender. In smoking they blow the smoke upward, saying, "Here, Wakanda, is the smoke." If the presence of enemies renders necessary the sending out of scouts, the pipes are filled and offered to them, and they are solemnly admonished to report on their return only the exact truth, and to be careful to observe well. When the first thunder is heard in the spring the sacred pipes are filled and held toward the sky, while the thunder-god is admonished to depart and cease from frightening his grandchildren. In the time of a fog the men of the Turtle subgens draw on the ground the figure of a turtle with its face toward the south. On the head, tail, middle of the back, and on each leg are placed small pieces of breechcloth with some tobacco. This is to make the fog disappear. Should an enemy appear in the lodge and put the pipe in his mouth, he can not be injured by any member of the tribe, as he is bound for the time by the laws of hospitality, and must be protected and sent to his home in safety. These Indians use the pipe when declaring war and when making peace. Among the Poncas at the election of chiefs, the chiefs-elect must put the sacred pipes to their mouths and inhale the smoke. If they should refuse to inhale it they would die, it is thought, before the end of the year. The election of Omaha chiefs is similar.

Major J. W. Powell states that when the Wyandot tribal council meets, the chief of a certain gens fills and lights a pipe, sending one puff of smoke to the heavens and another to the earth. The pipe is then handed to the sachem, who fills his mouth with smoke, and, turning from left to right with the sun, slowly puffs it out over the heads of the councilors who are sitting in a circle. He then hands the pipe to the man on his left, and it is smoked in turn by each person until it has passed around the circle, after which the sachem explains the object for which the council was called.

A possible evidence of the religious veneration with which the

pipe was regarded in America is furnished by the mound pipes, upon which the native sculptors expended a much greater amount of patient and careful labor than they devoted to any other implement. So skillfully executed are they that Dr. Rau does not hesitate to affirm that modern artists would find no small difficulty in reproducing them, even with the great advantage of metallic tools. These facts seem to have impressed themselves strongly upon the mind of the late Sir Daniel Wilson, who many years ago investigated thoroughly the narcotic arts and superstitions of the Americans, and to whom the writer is indebted for the main idea of the present paper. The mound pipes are, indeed, a suggestive theme, though the conclusions which archæologists have drawn from them are by no means unanimous. A remarkable depository of carved pipes was unearthed by Squier and Davis in one of the mounds of the group known as Mound City, in Ohio. From a single hearth they took nearly two hundred finely sculptured pipes, many of them, however, being broken and injured by the action of fire. Recalling the sacred associations connected in the mind of the Indian with the tobacco plant and the instrument of its use, theorists have found in this mound a possible altar devoted exclusively to nicotian rites. Without discussing the motives which may have led the builders of the mounds to deposit so many of these pipes in one place, we may assume with some confidence that the carved pipes were most probably totems. "Their sacred nature," remarks Henshaw, "would enable us to understand how naturally pipes would be selected as the medium for totemic representations."

Leaving for a time the regions where the pipe occupies so prominent a place in religious rites, we find, on approaching the Rio Grande, that the use of tobacco becomes of far less frequent occurrence. In the pueblos of the Southwest very few pipes have been found. The Indians of this region have, however, a sacred cigarette, the antiquity of which is indicated by repeated allusions to it in the pueblo folk lore. The Navajos share with the Moquis the smoke-prayer, in which the sacred smoke of the cigarette is blown east, north, west, and south, to propitiate the good spirits and drive away the evil ones. Cushing observed that the older men of Zuñi, in smoking cigarettes, would blow the smoke in different directions, closing their eyes, and muttering a few words which he regarded as invocations. In Mexico and Central America the pipe reappears, though here it is evidently of much less importance than in the North. One prominent example of its application to religious uses is furnished by Diego de Landa. In his Relación de Cosas de Yucatan, describing the curious native ceremony of baptism he says: "Tras esto (the priest) ivan los demas ayudantes del sacerdote con un manojo de flores y un

humaço que los indios usan chupar; y amagavan con cada uno dellos nueve vezes a cado mochacho, y despues davanle a oler las flores y a chupar el humaço." That this is not an isolated instance of the use of tobacco in religious practices in these regions is shown by the pipes and cigars pictured in some of the ancient manuscripts. Bancroft states that after some of the hideous human sacrifices made by the people of Central America, great fires were built, into which the men threw pipes, among other offerings. Among the remarkable sculptures of the "Palace of the Sun," at Palenque, occurs the figure of a priest dressed in a leopard's skin, a complicated head dress, and ruffles around his wrists and ankles. In his mouth, supported by both hands, is a tubular pipe, similar in shape and decoration to many that have been found in California and in other parts of the United States. In this figure the learned Dr. Hamy sees, and doubtless correctly, the performance of an act of worship. He says: "Le pontife souffle en l'honneur du Dieu dont l'image est sculptée au fond de la chapelle une large bouffée de tabac," and proceeds to trace the analogies which exist between this practice of the builders of Palenque and the rites of the mound-builders and California Indians, of whose tubular pipes he says: "Elles servent à souffler une fumée consacrée, dans certaines cérémonies religieuses, et le *medicine-man* sait, suivant les besoins, les transformer soit en tubes à ventouse, soit en porte-moxa."

The treatment of disease by means of tobacco and tobacco pipes, which is here suggested, may now claim attention. The "sucking cure," in which the medicine-man or sorcerer applies to the patient's body a tube of stone or bone and pretends to extract through it some small object, such as a stick or stone, is of world-wide distribution. In America the tube used is frequently the tobacco pipe, sometimes empty, and sometimes filled with burning tobacco. Vanegas, an early historian of California, asserts that stone tubes sometimes filled with lighted tobacco were often applied to the suffering part of the patient's body. Forbes states that in the same region, in 1728, Father Luyanto, of the Loreto Mission, "as a preliminary to baptism insisted on the abjuration of faith in the native jugglers or priests, and demanded the breaking and burning of their smoking tubes and other instruments and tokens of superstition in proof of this." Among the modern Apaches the medicine-man's diagnosis of a case is made by the pretended swallowing of a pipe filled with burning tobacco. It works out of his arm or leg, and if white the patient will recover; if colored, he is likely to die. Tubular pipes occur in many parts of the United States, and in California they are numerous. While they were designed primarily as smoking implements, they were no doubt often used, as here indicated, in the treatment of disease.

From the point of view here taken in regard to tobacco its most interesting use by far is for the purpose of producing a state of ecstasy or delirium in which, according to the barbaric theory of animism, the person under its influence could hold communication in dreams and visions with the spirits who brought disease and death, and also with those to whom the savage felt himself indebted for life and all its blessings. The importance attached to dreams by savages is well known. Schoolcraft, in 1823, noted the besotted and spellbound condition of the Indians of the Great Lake regions, due to their implicit belief in the prophetic nature of dreams. "Their whole lives," he remarks, "are rendered a perfect scene of doubts and fears and terrors by them. Their jugglers are both dreamers and dream interpreters." In ancient Mexico the will of the gods was made known to the four chief medicine-men in dreams, and Bandelier recalls the familiar story that Montezuma, previous to the coming of the Spaniards, being alarmed by mysterious prognostics, called upon the old men and women, and upon the medicine-men, to report what they might dream or had dreamed within a certain lapse of time. In the same country certain men were particularly expert in dream interpretation, so much so that they were generally applied to for that purpose.

It should be remembered that the capacity of the Indian to withstand the effect of narcotics is much less than that of the European, and that the native practice of inhaling the smoke secured a far deeper and more lasting effect than the modern method. Oviedo is authority for the statement that tobacco was greatly valued by the Caribbees, "who call it *kohiba*, and imagined when they were drunk with the fumes of it that they were in some sort inspired." The Carib sorcerer, in evoking a demon or spirit from his patient, would puff tobacco smoke into the air as an agreeable perfume to attract the spirit from the afflicted body. With the aid of tobacco smoke and darkness he could also hold communion with his own familiar demon or guardian spirit. "In La Española and the other islands," says Benzoni, "when their doctors wanted to cure a sick man, they went to the place where they were to administer the smoke, and when he was thoroughly intoxicated by it the cure was mostly effected. On returning to his senses he told a thousand stories of his having been at the councils of the gods, and other high visions." The Indians of California sometimes stupefied children with narcotic drink, in order to gain from the ensuing vision information about their enemies. Dr. E. B. Tylor notes similar practices in Darien, Brazil, and Peru. The Brazilian tribes took tobacco to produce ecstasy, and in this state had supernatural visions. The same custom obtained in North America. A peculiar use of the sweat

lodge (a common institution in America) was observed by Loskiel among the Delaware Indians. After a feast in honor of the fire-god and his twelve attendant manitous, a hut was constructed of skins stretched upon twelve poles tied together at the top. Into this hut twelve men were crowded, twelve red-hot stones were placed among them, and upon these stones an old man threw twelve pipefuls of tobacco. The men had to remain inside as long as they could endure the heat and smoke, and when taken out at last they were almost suffocated, generally falling in a swoon. The precise object of this ceremony is not mentioned, but it is probable that the dominant idea was that of a spiritual intercourse between the swooning men and the deities.

The origin of the custom of smoking tobacco may, with some degree of probability, be traced to the ceremonies here recounted. That stage of primitive culture which is characterized by a strong belief in the reality of dream figures and the prophetic nature of visions tended inevitably to engender a class of professional dreamers and soothsayers. When dreams were in great demand, it was natural that some man in every savage community, on account of a mental peculiarity—a taint of insanity, or some powerful nervous derangement—should become distinguished above his fellows for vivid and frequent visions. As the business of the prophet and seer increased, it became necessary for him to adopt artificial measures for bringing on the condition of stupor which was essential to the exercise of his calling. He therefore resorted to fasting, or, more frequently, to the use of narcotic drugs. Along the Amazon the seeds of *Mimosa acacioides* were thus employed; among the Peruvians and the Darien Indians it was the *Datura sanguinea;* in Brazil, the West Indies, and North America the great narcotic was tobacco.

In like manner it may be reasonably conjectured that tobacco did not become an article of sacrifice and incense until it had passed out of the hands of the medicine-men, by whom alone it was at first used. In every age men have offered in sacrifice that which they valued most—the best and first fruits, and the most precious of their flocks. Tobacco must have come into general use and become one of the Indian's most prized possessions before it was offered as a gift to his deities. It is not difficult to trace this advance from its restricted use by professional dreamers as just described. When men had learned that the sacred herb could drive away disease, recall the past and reveal the future, they naturally wished to try its effects upon themselves—to walk in person in the hidden land of spirits, instead of sending the medicine-man as a deputy. Thus, in time, every man became his own seer, tobacco rose in the estimation of the Indian above all his other possessions, and smoking became a common practice.

AN ETHNOLOGIC STUDY OF THE YURUKS.

By ALCIDE T. M. D'ANDRIA.

THE Yuruks are nomadic tribes whose existence is a phenomenon difficult to understand and to explain. Ethnologists consider them as direct descendants of the Turkomans, whose distinctive features they have preserved; while those properly called Turks, though descendants of the Turkomans, have mingled with Aryan and Semitic races, and lost their original characteristics. Mr. Riegler states that the Turks, owing to numerous crossings with various foreign races for several centuries, present nowadays important modifications in their type; while the ungovernable Yuruks are proud of their savage origin, and value themselves as superior to the Turks among whom they live.

The Yuruk has generally a large head, round face, high forehead, projecting chin, and long though not oblique eyes. His skin is brown, his hair dark or auburn; he has a very strong osseous frame, and is of medium height. Such is the physical description of the Yuruks.

As for the etymology of their name, it is entirely Persian, and is derived from the verb *yurumek*, which means *to walk*. In some provinces of Asia Minor they are called *Gueutchebe*. This word has the same meaning as *yurumek*, and is derived from the verb *gueutchmek*, which may be rendered in English by *to change lodging*. The literal meanings of their names show sufficiently the most striking side of their nature—they are nomadic. Their tribes are scattered over the Asiatic peninsula. Some ethnologists place their number at three hundred thousand, and M. Elisée Reclus reckons as many as a hundred different tribes. Each tribe appoints a chief called a *sheik*. His authority is absolute, and he fills the office of a judge to settle their quarrels.

The chief occupation of the Yuruks is the breeding of cattle. In winter they set their tents near their barns; but when spring approaches they fold them and remove to lands more favorable for the welfare of their animals. Through the warm months of the summer they live in the open air. If they happen to be in the vicinity of a forest, they apply themselves to wood-felling, and they dispose of the product of their labor in the neighboring cities or villages.

Their wives and daughters are very skillful in weaving carpets, particularly one kind known as *kilim*. Each tribe manufactures carpets having the same design and size; each family transmits to the children the design it possesses, and the young girls learn easily the art of weaving without the help of a pattern.

It is unnecessary to say that nomadic life is dear to them, as

can be testified by the following quatrain, which is taken from one of their patriotic songs:

> "There is no rest for the sovereign,
> And glory requires many toils and pains.
> For me, I would not exchange my poor attire
> For all the universe!"

The Ottoman Government has often tried to stop their wandering life, and many severe edicts have been issued for this purpose.

FIG. 1.—YURUK WOMEN AT THE SPRING.

The Sultan's idea was to destroy their tents, so as to confine them in one place where they might apply themselves to agriculture. The nomads submitted for a time, but their cattle in many places suffered so much from the sterility of the soil that the authorities were obliged to grant them again a permit for emigration.

The language of the Yuruks resembles much the Turkish. In their dialect, words and even syntactic forms are also found which recall the Persian and Arabic languages.

Their creed is Islamism, although they do not observe all its precepts. Thus, they build no mosques, and do not confine themselves to the obligation of the five daily prayers imposed upon all good Mohammedans. Neither do they undergo the long and painful fasting of the Ramazan. Their women do not cover their faces as do the Turkish ladies.

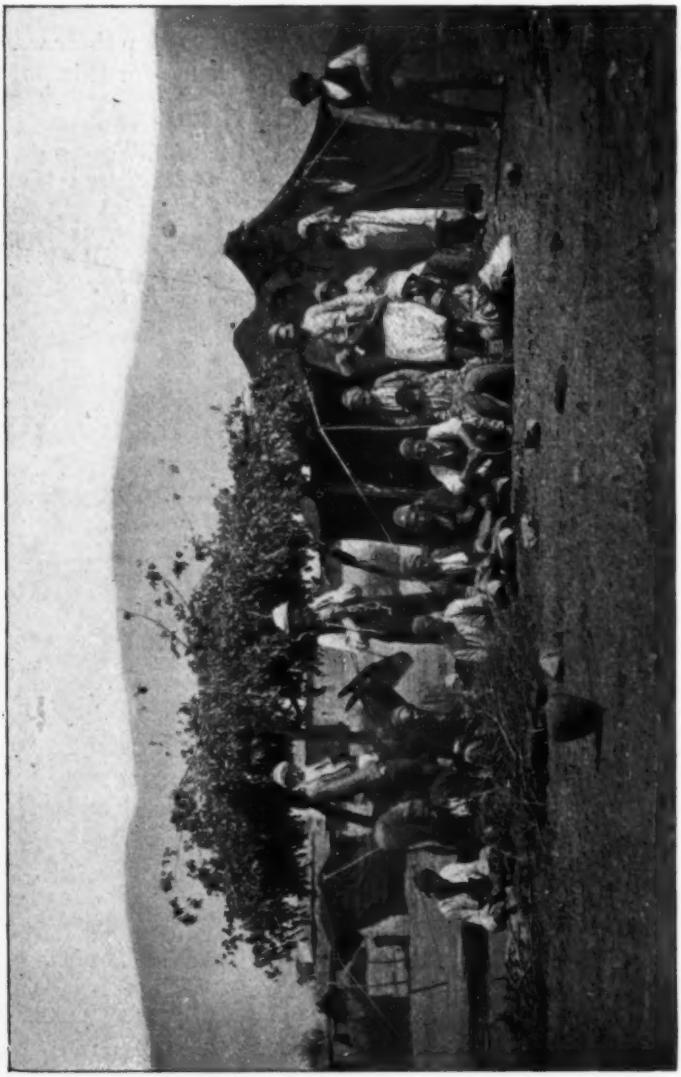

FIG. 2.—TENTS OF THE YURUKS.

The Yuruks who dwell in the plains which extend from the

Sipylus to the Tmolus Mountains are named "Kizil-Bach." Their tribe is the most important and the most numerous; they comprise nearly two thirds of the Yuruk element. In the ethnologic point of view their study presents the most interest.

The Kizil-Bach, as, in fact, all the Yuruks, are the followers of Ali, whom they consider as their prophet. Therefore, Mohammed has no worshipers among them, and this explains why they do not observe the precepts of the Koran.

A curious thing to notice is also a slight mixture of paganism in their creed. For instance, in the spring and fall of every year they set large tents in a remote place, and when night comes men and women gather to celebrate religious banquets and mysterious ceremonies, followed by songs and dances.

Their principal poems express veneration for Ali. They also possess remarkably exalted hymns to chant their adoration to the Supreme Being and their love for their brethren. The dance, performed only by the women, has an original and Asiatic character; its rhythm is grave and slow, the gestures and motions of the dancers show kindness and amiability for their guests. Only those initiated in their mysteries are allowed to attend the above ceremonies, while vigilant and unmerciful guardians, posted in the surroundings, prevent the approach of strangers on pain of immediate death.

Besides these banquets and nocturnal ceremonies, which recall the Saturnalia of the Romans in the time of Tiberius, another fact leads me to believe that the Yuruks have preserved pre-Islamitic doctrines that we can also trace in the darkest paganism. For instance, their belief in metempsychosis. The Yuruks, indeed, assert that human souls return into the bodies of animals, and that the spirits of the latter take also a human form and appear at determined epochs. This is certainly the reason why they are so kind to animals. M. Elisée Reclus says that a Yuruk loves his horse as much as his family. The horses have their place under the tent, and it is not uncommon to see them warmly wrapped in a magnificent robe when the Yuruk and his children are covered with rags. Some other customs attest also a pagan origin; in the Orient everybody knows that the Yuruks worship certain trees and rocks. These facts yield sufficient evidence that monotheism is by no means the essential dogma of their religion.

Among the qualities possessed by the Yuruk, hospitality is, no doubt, prominent. Deprived, by the very influence of his adventurous life, of all the fierce instincts which characterize the Turkomans; restricted, because of his occupations, to the woods, the plains, or the mountains; constantly exposed to the inclemency of the seasons, to dangers and enemies of all kinds, the Yuruk has conceived a generous and noble idea of hospitality, and he prac-

Fig. 3.—Yuruk Encampment.

tices it with disinterestedness and pleasure. His tent, whether in his presence or absence, is always opened to the traveler, and food and drink in abundance are given him. The tents of the Yuruks are square, and made of a sort of thick black woolen cloth.

Aside from the information I have given here, nothing precise is known of their private life. For instance, nobody ever knew what became of their dead, as no one has ever seen a cemetery. All I am able to say is that the body of the deceased is placed on a black mule, destined exclusively for that use, and thus carried to a mountain. There, I am not aware whether it is cremated or buried; but, as I was told that they also take a sheaf of firewood, it is safe to believe that cremation takes place.

No traveler has ever seen a Yuruk pray according to any rite. Yet it seems that they are not left without religious instruction, as a venerable old man, his hair dressed as a Persian dervish, comes once a year from Syria and remains awhile among them. The pilgrim becomes the object of their respect and devotion, and they give him the name of father.

Now, who is this man? What affinity between him and these Turkomans? What does he teach them? Why do they call him father? All these questions involve as many mysteries.

FIG. 3.—YURUK ENCAMPMENT.

Men are often absent in the woods or on the mountains, and their wives remain alone in the tents, but they are secure from all danger, as they have weapons and know how to use them. Among the women they select one in each tribe whose age and personal merits render her deserving of distinction, and they invest her with a superior authority. All the women show her a profound veneration and blindly obey her orders. Even men kiss her hand, and it is customary that every stranger who arrives in the tribe should do the same.

All people agree in acknowledging the good morality of the Yuruk, also his peaceful character, his sober habits and honesty. The very thought of stealing is a crime in his mind, and the weapons he carries he only uses for personal defense.

Here are a few interesting details about the way their marriages are contracted: First of all, I must say that no religious ceremony is performed, as they have neither mosques nor priest, and no person among them is invested with a sacred character. Marriages among young people of different races are strictly prohibited. Therefore, when a young man has remarked among the girls of his tribe the one whom he would like to marry, he delegates a third person, who is usually a friend, to the father of the girl, to announce his intention. If the father sees no objection' the delegate presents him a small sum of money, and that gift in their dialect is called *aghirlik*—that is, *weight*. Afterward the

FIG. 4.—MARKET DAY IN A YUKUE VILLAGE.

parents and friends of the intended go to the tent of the young lady, where, as soon as they arrive, they are offered the sherbet or sorbet, a beverage made with water, lemon, sugar, amber and other spices. The purpose of this visit is to appoint a day for the marriage. When the time comes the young man engages a numerous escort of friends, and they start all together for the tent of the young woman. The bride has also gathered around her a large number of her friends to protect her. When the escort of the groom is near, the bride's protectors utter, at a signal, the wildest cries, run to the aggressors, insult them, and endeavor to defend the access of the tent. Insults and even blows are profusely exchanged between the two camps. This sham fight ends when one of the bravest succeeds in carrying off a goat or a sheep belonging to the father-in-law, and immolates it at once.

The blood shed is considered as a sacred libation, and from that moment the rights of the groom over his wife are recognized. The two families and all their friends are invited to a banquet in which they eat the sheep that was sacrificed.

Before night the bride is escorted to the tent of her husband on horseback. There, before alighting, she must remove the reins from her horse and throw them with force over the tent. If she succeeds in flinging them on the other side, without their touching the tent, they all declare it a happy omen.

At last some women execute dances appropriate to the circumstances, and, as they dance, all armed for the occasion, the effect of their graceful movements, in the magnificence and freshness of the Oriental twilight, is very impressive.

When all these formalities are accomplished, the guests retire, and the husband, accompanied by his most intimate friends, is led to the tent where his young wife awaits him. All the Yuruks espouse one woman at a time; polygamy is prohibited and severely punished.

FIG. 4.—MARKET DAY IN A YURUK VILLAGE.

DR. D. G. BRINTON and Dr. de la Tourette are agreed that nervous diseases and hysteria are not specially developed by civilization, as is commonly supposed. Dr. Brinton, in Science, quotes travelers for evidence that violent and epidemic nervous seizures are very common in uncultivated nations. Castian describes them among the Sibiric tribes. An unexpected blow on the outside of a tent will throw its occupants into spasms. The early Jesuit missionaries painted extraordinary pictures of epidemic nervous maladies among the Iroquois and Hurons. Scenes of this kind were witnessed in the middle ages that are impossible to-day. The hypothesis is advanced by Dr. I. C. Rosse, of Georgia Medical College, that a sudden change in the social habit and condition of any race, at any stage of advancement, may result in a prompt development of nervous disease; and that a stable high civilization may excite nervous disorders less than unstable conditions of lower grades of advancement.

MODERN MIRACLES.

By Prof. E. P. EVANS.

IF, as it has often been stated, the age of miracles in the history of religions is past, it is certain that the age of marvels in the evolution of science is just beginning. The Orient, which from time immemorial has been the chief seat and source of theosophic systems and theurgic traditions, is still peculiarly prolific in all sorts of magical phenomena and other mysterious manifestations.

In illustration of this fact we may refer to the performances of the Arabian fakirs which excited so great astonishment at the Paris Exposition of 1889, and to the more recent but equally wonderful feats of the East Indian, Soliman, in the Panoptikum at Berlin. These fakirs are called *'Aïssavîdya* from the name of the founder of the fraternity, Sid Mohammed Ben 'Aïssa, a saint of royal lineage born at Mekinez, in Morocco, about the end of the fifteenth century. *'Aïssa*, or *'Yissa*, is the Arabic for Jesus: *'Aïssavîdya* is therefore etymologically synonymous with Jesuits, and both orders are really somewhat akin in scope and spirit, although to a superficial observer the Mohammedan society may seem to have little in common with that founded by Ignatius Loyola, except the name and the general principle of absolute obedience, which is thus forcibly inculcated in one of 'Aïssa's statutes: "Thou shalt be in the hands of thy sheik like a corpse in the hands of the embalmer; his commands are the commands of God himself." In this injunction the Jesuitical doctrine of the "sacrifice of the intellect" is pushed to its extreme consequences. It is also a curious coincidence that 'Aïssa should have established in northern Africa a religious order having for its general aim the revival and propagation of Islam, at the same time that Loyola established a religious order in Paris under the same name, having for its object the revival and propagation of Catholicism. Both orders are likewise exceedingly intolerant and fanatical, notwithstanding wide differences in their methods of procedure and the manner in which this zealotry manifests itself.

Besides the common purpose of propagandism as an association, each individual member of the order aspires by means of a severely ascetic life and long-continued physical and spiritual discipline to attain perfection through emancipation from the flesh with all its trammels and torments. In order to arrive at this state, called *Tauhidi*, and corresponding to the *Jîvanmukti* (release from the body before death) of the Hindu *Yogi*, the candidate passes through seven stages of penitential purification, each more rigorous than the preceding one, resulting not only in the com-

plete subjection of the moral and mental faculties of the adept to the will of his superior, but also, as it would seem, in a change of the vital processes and a suspension of the ordinary conditions of bodily existence, which give him immunity from pain and enable him to inflict upon himself wounds that would be fatal to common mortals.

At Paris the performance took place every evening at nine o'clock in the upper story of the Moorish *café*, in the Rue du Caire, of the Oriental quarter. Four 'Aïssavîdya, with their sheik, squatted in Eastern fashion on a carpeted platform, in the center of which stood a brazier of burning coals. The exhibition began with a monotonous sing-song, the burden of which was the invocation of 'Aïssa and Allah, accompanied by a sort of tambourine or tom-tom edged with bells. The music was at first slow and rather low, but soon went faster and grew louder, until it rose to a fearful howl and furious din. At this juncture one of the fakirs sprang up and, throwing off his upper garment, began to dance with his hands on his hips, his head bent forward, and his eyes intently fixed on the sheik. This dance, called *Ishdeb*, became at every moment wilder and the swaying motion of the dancer's body more violent, until he fell down in a fit of exhaustion, foaming at the mouth and his eyes in a "fine frenzy rolling." In this state of ecstasy he is supposed to be possessed by the spirit of 'Aïssa and thereby rendered invulnerable to the sharpest weapons and proof against the deadliest poisons. We may add that Soliman at Berlin prepared himself for the ordeal of fire and sword, not by music and dancing, but by burning a powder and inhaling the smoke, which, however, did not produce any perceptibly stupefying or exhilarating effect upon him. He is a member of the order of Saadi, founded in 1335 by Saadeddin Jebari. Each order seems to have its own method of procedure in this respect, which forms a part of its secret science.

In a short time the fakir had sufficiently recovered from his trance to stand up, and, when the sheik pointed to the brazier, he thrust his hand into it, seized some of the live coals, blew them till they emitted sparks, bit off pieces of them, as one would bite an apple, and eagerly ate them up. He then went to a large prickly cactus, which was standing on the platform, plucked a leaf armed with strong spines, bit off a piece, and swallowed it. With equal avidity he crunched and consumed thin sheets of glass. Fragments of the cactus and the glass were handed to the spectators, who examined them and convinced themselves that they were really the substances they were represented to be. An attendant brought in a shovel, the iron part of which was red-hot, so that a bit of paper thrown upon it flashed at once into flame. The fakir took the wooden handle of the shovel with his right hand, placed

his left hand on the glowing iron plate, which he also licked with apparent relish, and then stood upon it with his bare feet until it became black. This last exploit filled the air with a faint odor of burned horn. A sword, so sharp that it cut a piece of paper in two when drawn across the edge, was handed to the fakir, who thrust it with all his force against his throat, his breast, and his sides. The sword was then held in a horizontal position about three feet from the ground with the edge upward, by the servant who took hold of the point, which was wrapped in several folds of cloth for the protection of his hand, and by another 'Aïssaui, who held it by the hilt. The fakir placed his hands on the shoulders of the two men and, leaping up barefoot on the edge of the sword, stood there for some seconds. He then stripped and, resting his naked abdomen on the edge of the sword, balanced himself in the air without touching the floor with his feet, the sheik meanwhile pressing down upon the fakir's back with the whole weight of his body. The fakir also thrust a dagger from the inside of his mouth through his cheek, so that the point projected more than an inch. Finally, he took a serpent out of a box, and, after irritating it into fierce anger, let it bite various parts of his person; at last he himself bit off the head of the venomous reptile and devoured nearly half of its body.

Having thus gorged his barbarous appetite, he resumed his dance in the same rapid measure, in which he had finished it, but the movement became gradually slower, and in due time, after kissing the yellow turban of the sheik, he sat down again, "clothed and in his right mind."

Another fakir danced himself into a trance and fed upon snakes and scorpions, apparently relishing this limited but piquant bill of fare. In conclusion, the sheik himself performed the most marvelous feat of all: with the point of a dagger he lifted his right eye out of its socket, so that one could see into the cavity, the cornea assuming a dull, glassy appearance so long as the eye rested on the point of the dagger, but no sooner was it replaced and gently rubbed than it became clear again and seemed to be as serviceable as ever. Several medical and scientific men examined the fakir thoroughly after the performance was over, and unanimously declared that none of these feats left the slightest trace of a wound on any part of his body, nor did they draw a single drop of blood. They furthermore affirmed that, so far as they could discover, no jugglery or sleight of hand was practiced.

That these things actually happened is as conclusively established as the occurrence of any event can be by human and even expert testimony. The literature of the subject is quite voluminous and rapidly increasing in extent, corresponding in this respect

with the growth and development of anthropology and ethnopsychology. Missionaries, tourists, government officials, and the most eminent English, French, German, and Italian scientists, who have witnessed these exhibitions in India and other Oriental countries, all agree as to the genuineness of the phenomena, although no one has yet been able to give a satisfactory explanation of them. If we accept the *argumentum ex consensu gentium* as valid, the evidence is overwhelming and the proof complete.

Indeed, one need not go so far away in search of such manifestations. The so-called Choreutæ (dancers) of the fourteenth and fifteenth centuries, the Flagellants of a later period, and similar fanatical sects, are not to be considered in this connection, since their object was to inflict pain upon themselves, the physical suffering being regarded as a sacrament or efficient means of grace. There is, however, quite a remarkable resemblance between the marvelous feats of Arabian and Indian fakirs and those performed by Jansenist convulsionaries in the last century (1730–1762) at the grave of their ascetic saint, Francis of Paris, in the suburban church of St. Medardus, the genuineness of which is not denied by their bitter enemies, the Jesuits, and is even admitted by such scrutinizing skeptics as Hume and Diderot. These religious enthusiasts maltreated their bodies much in the same way as the fakirs and with like impunity, and regarded such actions as contributing to their spiritual growth and perfection. It was a sort of homœopathic treatment, the principle of *similia similibus* applied to the cure of souls, whose infirmities were indicated by bodily symptoms and required vigorous remedies. Thus, an oppression of the chest, which had a pathological significance in relation to the spirit, pointed to the therapeutic necessity of beating it with the greatest violence; if the convulsionary had a sense of burning heat, he exposed himself to the flames; an acute and boring pain in the mouth, neck, eye, or any other organ required a dagger to be thrust into the afflicted part, but, strangely enough, no force could make the sharpest instrument enter the flesh or inflict a wound. If we are to accept autoptic testimony, given by shrewd observers, who would have been glad to expose any imposture, these enthusiasts could eat the most injurious things, swallow poisons, and lie for hours in the fire, like salamanders, without singeing a hair or having any smell of burning on their persons.

Doubtless, as Charcot, Lombroso, Mendel, and other scientists suggest, hypnotism may furnish a partial solution of this physiological and psychological puzzle; but hypnotism, although recognized as a fact, still remains a mystery, and differs from a miracle only in being attributed to natural instead of supernatural causes. It is well known that, in obedience to hypnotic suggestion, persons will eat the most unpalatable and even disgusting substances as

though they were the rarest delicacies; the hypnotic state is also attended by "analgesia" or freedom from pain, and serves as an effective anodyne in dental and surgical operations; but we can recall no well-authenticated case in which it has rendered the human body incombustible. The hypnotizer can prevent the subject of his experiment from feeling the surgeon's knife, or cause him to regard the cutting as an agreeable sensation, but we are not aware that he is able to make the flesh impenetrable to the scalpel, although it is possible for him, as Donato has shown, to thrust sharp instruments into the arm of a hypnotized person without drawing blood or leaving a visible wound. By hypnotic suggestion a man may believe himself to be a dog, a wolf, or any other animal, and act accordingly; and this imaginary metamorphosis may perhaps explain the supposed existence of werewolves. In like manner, pure water may produce an intoxicating effect, while, on the contrary, alcohol ceases to inebriate; and a simple piece of paper placed on the skin may raise a blister, although the strongest irritant fails to do so. Here we have to deal with enigmas of the physical and psychical organization, hitherto unsuspected, the study of which opens up a wide and fruitful field for research.

THE PHENOMENA OF DEATH IN BATTLE.

By GEORGE L. KILMER.

IN an article printed in the Monthly for June, 1892, I presented some of the phenomena of the soldier's first actions under a death-hurt. A field for investigation lying just beyond that—as I infer from the incomplete records and deductions offered by men of science—is that of the phenomena of death itself. In a casual way I stated in my paper that the symptoms attending death in battle might, in certain cases, be determined by the appearances of the bodies, and cited a remarkable scene at Antietam, where dead Confederates in one place, to the number of several hundred, seemed to have been killed instantly, and to have retained in death something of the last attitudes of their combative life. After my manuscript had been given to the editor, my attention was called to a brief discussion of this question in a sketch by Dr. S. Weir Mitchell, in the Century for February, 1892. The views of Dr. Mitchell are not openly declared in his Century article, but he quotes, on the lips of fictitious characters, the opinions of Generals Grant, Sherman, and Sheridan, and refers to Dr. J. H. Brinton, an army surgeon, who is on record as a very positive witness in this matter. General Sherman, according to Dr. Mitchell, told the story of a soldier killed by a bullet in

the brain while kneeling at a spring to drink, who retained his extraordinary attitude naturally in death. General Grant, when appealed to, said that it could not be true, as he had never seen a single instance where a soldier, shot dead, retained the posture held in life, and his attention had never been called to it in the war. General Sheridan stated that he had often seen it. I wrote what I recalled of the Antietam scene thirty years after, and, never having had a doubt raised but such things could be and were not rare in war, I assumed the phenomenon to be fairly well established, and that citation without proof would not tax the credulity of readers. Yet the denial by General Grant caused me to question my own senses or my memory. As against both Sherman and Sheridan, the one sanguine and imaginative, the other impulsive and good-natured, it would seem that, all things being equal, a question of fact would have the more competent judge in Grant. General Grant went no further in his denial than to say that he had never seen the phenomenon. There are veterans who, having had the best of opportunities for seeing all phases of the battlefield, not only say that they never saw a case of the kind, but, resting upon professional knowledge, assert its impossibility. For my own part, I can report only what I saw in my capacity as a combatant—that is, extraordinary attitudes of dead men on certain fields. Reports of comrades of analogous cases, and the quite prevalent belief that the manifestation was possible, led to the acceptance of it as a natural yet withal a rare occurrence. The fact that military men, and more especially surgeons who have been on the field, are skeptical on the point, that such phenomena are comparatively rare, and that scientific observations have been recorded in but few instances, makes the subject one for extreme caution and conservatism in treatment. In my paper on wounded soldiers I cited the cases of officers killed while leading the charge, who in death held their sword-arms out as when last seen in life. The inference drawn was that death must have been instantaneous. The Antietam scene described was of similar character, yet extraordinary in the number of examples of the same order. I confess that I did not see on any other of the score of fields where I was present a scene at all comparable to that at Antietam, but competent witnesses have reported similar things on other fields, as well as on different parts of that field.

The field of Antietam was peculiarly favorable for the development of the phenomenon, which for brevity, borrowing a term from Surgeon Brinton's record of research, I will call battlefield rigor. It was the hardest fought battle in the East—perhaps in the whole country. The Confederates were at bay, with the Potomac River behind them, and the Union soldiers were exultant over the enemy's dilemma, and the fact that for once battle was

invited on their own soil. Circumstances have relegated it to the background, but at one time it was deemed worthy the best efforts of descriptive writers. Charles Carleton Coffin, the war correspondent and historian, wrote of one of the scenes there in language that will seem to many overcolored. Speaking of an action almost contemporaneous with that at the north cornfield of which I have written, he says: "The Confederates had gone down as grass before the scythe. . . . Resolution and energy still lingered on the pallid cheeks, in the set teeth, in the griping hand. I recall a soldier with the cartridge between his thumb and finger, the end of the cartridge bitten off, and the paper between his teeth, when the bullet pierced his heart and the machinery of life —all the muscles and nerves—came to a standstill. A young lieutenant had fallen in trying to rally his men; his hand was still firmly grasping his sword, and determination was visible in every line of his face."

Curiously enough, Surgeon Brinton's field records, which form the basis of a paper referred to in Dr. Mitchell's remarks on the subject, include three Antietam scenes. The doctor confesses in the opening paragraph of his article (American Journal of the Medical Sciences, vol. xix, p. 87) that this line of investigation was a comparatively new one at the close of the war, 1865. He says: "I have been greatly surprised at the extraordinary attitudes presented by the bodies of those who had fallen with wounds apparently instantaneously fatal—as in the head or heart. In many instances the body was rigid throughout, and the position unquestionably that of the last moment of life. The muscles had, as it were, been surprised by death, and the limbs remained set and fixed in the position held at the moment of the reception of the fatal wound."

In the cornfield, along the sunken road at Antietam (the scene of Mr. Coffin's description), Dr. Brinton saw a Confederate corpse semi-erect, one foot on the ground, one knee against a bank of earth, and one arm stretched forward on a low breastwork. His musket, with rammer in, lay on the ground, and the appearances indicated that he had been killed while rising to load and fire. He was shot through the center of the forehead. In the field adjoining the doctor counted nearly forty dead Confederates, some with their arms rigidly in the air, some with legs drawn and fixed, and many with trunks drawn and fixed. The positions were "not those of the relaxation of death," but were due to "final muscular action at the last moment of life, in the spasm of which the muscles set and remained rigid." The wounds were chiefly in the chest, though some were in the head and abdomen. His observations were made thirty-six hours after death.

Another Antietam case included in Dr. Brinton's list, but re-

ported by Surgeon Thomas B. Read, was the corpse of a Union soldier with his right arm raised above his head and rigidly fixed, his hand still holding the cap with which he had been cheering on his comrades.

Aside from the desperate nature of the fighting at Antietam, the situation was especially favorable to these phenomena, particularly on the Confederate side. They had fought nine battles and engagements within one month, besides marching over two hundred miles. The troops engaged on the portions of the field under consideration had fought at South Mountain two days before—September 14th—had been alert all night on the 14th, 15th, and 16th, marching, countermarching, and skirmishing constantly, and were run down physically from hunger and general exhaustion. They had subsisted for several days upon green corn and apples, and had been one month on half rations of meal and bacon. The day—September 17th—was about like sultry August weather in the North, close and lowery in the morning, followed by a burning sun. The night of the battle was sweltering hot on the field. These circumstances may have played a part in the development of instantaneous rigor.

The first cases that came to the eye of Dr. Brinton were at Belmont, Mo., November 7, 1861. One was a Union soldier kneeling by a tree, in the act of firing, and shot obliquely through the head, front to back. His warm body rested on right knee and leg, left leg bent, with foot on the ground; the left hand firmly clinched the barrel of his musket, which rested with the butt on the ground. The soldier's head drooped to the chest, and rested against the tree. Attitude generally forward, jaw fixed, rigidity perfect. The doctor supposed him to be alive, and could scarcely believe that death rested upon a statue so lifelike. Another Union soldier, shot near the heart, mounted a straying mule and rode beside the doctor some distance. Soon the glazed eyeballs gave unequivocal signs of death, but the body rode on upright. After a time the mule was needed for a live victim, and the body of the other was so firm and rigid that it required force to loosen the knee-grip on the animal's shoulders.

Belmont was fought in autumn, yet the physical activity was such as to generate great bodily heat. It was a running fight for seven hours through wood and marsh. The desperate nature of the struggle is shown by the list of casualties. On the average during the war the proportion of killed and mortally wounded to wounded was one to three. In four of the five regiments engaged at Belmont the proportion was over one to two. The Seventh Iowa lost 188 killed, wounded, and missing. The death-list reached 74, leaving 114 for surviving wounded—over one and a quarter to two.

At Williamsburg, Va., May 5, 1862, Surgeon Read reported a

Zouave with one leg half over a fence, body crawling forward, one hand clinched and raised to level of forehead, with palmar surface outward, as if to ward off evil. Williamsburg was fought during a rain, but the men wore overcoats, the ground was low and heavily wooded, the troops new to war—like those at Belmont—and the mental strain and excitement would be favorable to bodily heat. That field also brought forth a bit of the kind of historical description termed fanciful. It is from the pen of Warren Lee Goss, who has published several narratives of the civil war. He was a soldier in the Union ranks at Williamsburg, and states that after the engagement he visited the scene of a charge in front of the Confederate fort. "Advancing through the tangled mass of logs and stumps, I saw one of our men aiming over the branch of a fallen tree which lay among the tangled abatis. I called to him, but he did not turn nor move. Advancing nearer, I put my hand on his shoulder, looked in his face, and started back. He was dead—shot through the brain—and so suddenly had the end come that his rigid right hand grasped his musket, and he still preserved the attitude of watchfulness, literally occupying his post after death."

A case reported to Dr. Brinton from Goldsboro, N. C., is one of the most striking on record, and it is to be regretted that particulars as to atmospheric and other conditions are wanting. Otherwise the details are most complete. A party of Union cavalry met some dismounted Confederates, and the latter, taking alarm, sprang to their saddles. The Union men fired a volley, and all of the Confederates rode off save one. He was in position preparing to mount, his face turned toward the advancing enemy, who were about to fire again when their leader restrained them, and told them to capture him. Riding up, they found a corpse with one foot in the stirrup, left hand grasping the bridle and mane of the horse, right hand clasping carbine near muzzle, stock resting on ground. Every muscle was rigid in death, and it was difficult to detach the fingers from the carbine, bridle, and mane. The body was laid down, and the same positions and inflexibility were retained by all the members. There were two wounds, one at the right of the spine, emerging near the heart, the other in the right temple.

Another case reported at second hand to Dr. Brinton, but vouched for to him, was that of a cavalryman of the Fourth Wisconsin, who in a skirmish in Louisiana was shot through the heart. His comrades placed him alone in a buggy, which was dragged for an hour by a rope attached to a saddle, the man dying meanwhile, and his body sitting bolt upright and rigid.

The cases examined by Dr. Brinton were sufficient to fully establish all that he claims—namely, the existence of a rigor pecul-

iar to the battlefield which is as instantaneous as the death with which it is synchronous. He states that he frequently passed without examination corpses holding muskets in grasp, pointing forward as if in a charge; bodies prone, face to earth; trunks bent, limbs apparently rigid. From other sources come reports of similar phenomena in more or less details. In a compilation of surgical reports by J. G. Chenu (Rapport au Conseil de Santé des Armées, 1865), Surgeon Perir, from the field of Alma, Boudin from Inkerman, and Armand from Magenta, named many general and special appearances of the phenomena. At Magenta many bodies held to their weapons, even those lying face downward. The conclusion of M. Armand, appended to his report, was that death came so suddenly that the hands had not time to let go. These were head shots. The fighting at Magenta was again terrific, and it was warm June weather. The struggle on the part of the French side was for possession of the town, the key to the position, and it was carried house by house. On the scene of one hand-to-hand combat a corpse was found with the arms raised in front, one bent, one extended, with fists clutched; also a dead hussar on a fallen horse, almost intact in saddle, but leaning on the right side, holding his saber at a thrust. The Magenta cases were seen by the surgeons when forty-eight hours old.

At Inkerman, fought in November, during a dull, foggy rain, M. Boudin saw numberless cases where the bodies rested on the knees, with guns in firm clasp, cartridges in the mouth, and in some instances arms upraised, as though parrying blows. "Long files of the dead seemed to need but the impulse of vital breath to recommence the action of battle." An eye-witness's off-hand description of scenes on that field is found in W. H. Russell's correspondence to the London Times. He said: "The battle of Inkerman admits of no description. It was a series of dreadful deeds of daring, of sanguinary hand-to-hand fights, of despairing rallies, of desperate assaults, in glens and valleys, in brushwood glades and remote dells. . . .

"The British and French, many of whom had been murdered by the Russians as they lay wounded, wore terrible frowns on their faces, with which the agonies of death had clad them. Some in their last throes had torn up the earth in their hands, and held the grass between their fingers up toward heaven."

At Alma, M. Perir saw a great number of cases. One in particular he reported where the body lay upon the side, legs bent, hands lifted at joints, and head thrown back as if in prayer. Alma was fought in September (in the Crimea). Russell termed it one of the most bloody and determined struggles in the annals of war. The allies charged through the waters of the Alma up the steeps to the Russian batteries on the crest.

Instantaneous rigor following violent death has been assumed to be ordinary *rigor mortis*, hastened in development by circumstances, or a rigidity of tetanic character. Dr. Carpenter, the English physician, held to the latter theory, and believed that the rigidity ceased after a few hours, to be succeeded by relaxation and ordinary *rigor mortis* in turn. Dr. Brinton, reviewing all other theories, claimed that the phenomena on the battlefield are unique. "Ordinary *rigor mortis*," he wrote, "is developed after muscular irritability has ceased, but before putrefaction sets in. The appearance of battlefield rigor is probably synchronous with violent death.

"In ordinary *rigor mortis* the march is downward; the parts first affected are the neck and jaw; the lower jaw, if previously relaxed, is drawn up; flexor muscles are supposed to be affected in a greater degree. Battlefield rigor affects probably all regions alike at once.

"Ordinary *rigor mortis* is usually of twenty-four to thirty-six hours' duration; battlefield rigor remains longer than is supposed. . . . The prolonged continuance shows that it is not tetanic nor followed by *rigor mortis* proper." The doctor saw cases of it twenty-four to forty-eight hours and once sixty hours after death. Armand saw it at Magenta twenty-four hours old and Perir at Alma forty-eight hours after death. Dr. Brinton's paper closes with this brief summary of the distinctive features of battlefield rigor:

"The rigor is developed at the instant of death.

"The cadaveric attitudes are those of the last moment of life.

"The death most probably is instantaneous and unaccompanied by convulsions or agony.

"The rigor is probably more lasting than is usually supposed.

"It is extremely doubtful whether this instantaneous rigor of sudden death or rigor of the battlefield is succeeded by flexibility, in its turn to be followed by ordinary *rigor mortis*."

This subject lies, of course, beyond the realm of experiment. If *rigor mortis* is due, as is believed, to solidification of the juices of the muscles by the acid conditions developed therein, marked chemical changes, either rapid or prolonged, follow death under ordinary circumstances. In what degree may the solidification be hastened by extraordinary violence in death? We learn that protoplasm is subject to peculiar changes under peculiar conditions; that it contracts under electric shocks, and that certain forms of it coagulate under temperatures varying from 100° to 122° Fahr., a species of "heat-stiffening" illustrated by the coagulation of the white of an egg. The presence of certain salts will cause muscle juice (myosin) to coagulate at a temperature possible to be attained in the system of a hard-working man on a hot day,

and a slight degree of acidity in the muscle juice lowers the temperature for coagulation; so that hard-worked and heated muscles are, upon chemical grounds, susceptible to the onset of rigor. The most remarkable cases of battlefield rigor seem to develop under extraordinary heat. Given heat and the release of blood pressure, the sudden check of muscular energy consequent upon the wound cuts off from the protoplasm all healthy expenditure of waste, and its action may be brought to a halt so sudden and so effectual as to preclude the slightest change of attitude beyond what may be caused by external forces. Reduced to its plainest terms the idea is as follows: Muscular action and excitement develop heat and chemical action. The myosin, or muscle juice, normally alkaline, is by hard work and excitement rendered acid. Heat and acidity being present in the muscles, tetanic or early *rigor-mortis* contractions might be expected in case of sudden death.

Again, the outstretched hand of the soldier, the grasp of weapons—even the fixing of the eyeballs in angry stare—are acts of the will. If death cuts short the power to will a reaction in the muscles involved by instantly destroying the nerve centers controlling the expanded member, why should the muscles contract any more than they would expand, if death came at the moment of contraction?

The immediate effect of an electric current of lethal energy comes nearest to what must be supposed as the manifestations attending instantaneous death in the heat of individual action. In an electric chair, at the moment of contact with the deadly current, the entire muscular system of the victim is thrown into a state of sudden and severe rigidity, lasting until the electrode is removed. All bodily sensation, motion, and consciousness are suspended at the same time; that is to say, the cessation of consciousness and the physical death—"total paralysis of all the vital organs and the nervous centers by which they are directly or indirectly vitalized, and by which the muscles of the extremities are actuated so that when the current is broken there can be no reflex action of the muscles, such as would indicate the presence of residual life energy or the possibility of resuscitation"—are synchronous. In the case of McElvaine, executed at Sing Sing, February 8, 1892, the reflex action of the voluntary muscles was tested approximately two or three minutes after the breaking of the current, and was found to be "absolutely unresponsive to ordinary mechanical stimuli." Dr. Van Gieson, in his report of the experiment, says: "This tends to show how superlatively complete and far-reaching the effects of the current are in abolishing life, not only in the concrete form, but also in the integral activities of the body, which, in other forms of sudden and vio-

lent death, is liable to persist for a time after life is extinct. From observation at this execution, as well as at the subsequent examination of the body, the current appears at first not only to extinguish life in the ordinary sense of the word, so far as consciousness, feeling, and volition are concerned, with overwhelming suddenness, but reaches beyond this, and destroys the energies of the individual component parts of the body, so that they can not be raised into activity by artificial mechanical stimulation, as is usually the case in sudden violent death."

The same thought has been applied to the phenomena of battlefield rigor. M. Armand wrote of the Magenta cases in 1859, "Death came so sudden that hands holding weapons had not time to let go." Dr. Brinton, in 1865, wrote, "The muscles had, as it were, been surprised by death, and limbs remained set and fixed in the position held at the moment of receiving the fatal wound."

Lightning strokes have produced like phenomena. Men and animals have been found dead in upright postures, a horse even standing on all fours, with his eyes wide open and nostrils dilated by the terror which the storm evoked. If rigidity can be instantaneous in any one case, why not in another where similar causes work upon the same elements?

There is still a link awaiting further physiological research to connect the manifestations attending deaths in battle action with those under the electric current. Huxley asserted that the matter of life depends on carbonic acid, water, and ammonia brought together under certain conditions, and that the withdrawal of any one of them puts an end to vital phenomena; also, that every form of human action is resolvable into muscular contractions, or transitory changes in the relative positions of the parts of a muscle. In 1868 he said: "Perhaps it would not yet be safe to say that all forms of protoplasm are affected by electric shocks; and yet the number of cases in which the contraction of protoplasm is shown to be affected by this agency increases every day."

Therefore the sudden appearance of agents in the nature of electricity and heat may change the combination of acid, water, and ammonia that causes the constant transition of the molecules of a muscle, and when that proportion changes and transition ceases, everything is at a dead stop until other combinations set in motion other changes that give rise to a new order of phenomena. The first stage is vital life, the last putrefaction, and the interim rigidity. The electric current causes unconsciousness and muscular death at one stroke. In battle the wound may produce swift unconsciousness. May it not also let loose a stored supply of heat to augment the already intense heat distributed by the energy of passion and physical action and thus stiffen the

muscle jelly? Or has the capacity for spasmodic reaction been exhausted by the previous overexertion of the soldier—volition being cut short by the wound?

Some men of science not only admit the validity of the evidence offered as to the appearancce of phenomenal rigor under war wounds as well as electric shocks, but assume it as an established physiological fact, without, however, accounting for it. Dr. Mitchell, in his indirect suggestions before mentioned, leaves no reason to doubt that he believes in it. Dr. Brinton and other army surgeons familiar with the phenomenon have speculated as to its causes, and almost all medical men who are not familiar with it in actual experience are curious as to what proof or explanations may be produced.

There is one other form of manifestations of the battlefield almost as unique, though not so startling, as instantaneous rigor, and being more frequently encountered has doubtless impressed itself more widely upon the minds of soldiers and visitants to the field. At first thought it seems but reasonable that the intensity of battle passion and energy should leave its mark upon the forms and features of combatants who die in the midst of the fray. *Per contra*, it seems odd that corpses made so by violence in the midst of violence should sometimes wear on their faces the peaceful look of calmness usually associated with quiet death-beds. I mentioned in the paper of last year, on wounds, that many of the dead appear to have passed away in a state of mental composure and freedom from pain. Often in contemplating these scenes one is surprised at the contrasts between the happy smile on the dead warrior's face and the blood, the spent missiles, the weapons, and other ghastly symbols of the strife that has passed, lying beside him. Here, again, Nature has wrought a good work. Wrath is soon spent, the inciting din of battle quickly hushed; pain and melancholy thoughts, even surprise that life remains, swiftly loosen the chords that once bound the now suffering man to the warrior's terrible trade. Thought, fanciful it may be but yet enchanting, takes him miles and leagues away, the while his torn body lies not ten feet from the cannon that mangled it, and the smoke of the fatal discharge still hovers about the scene. Again he is only a man. He tries bravely to live, forgetting to hate; makes light of his condition, and may be helps another victim supposed to be worse off than himself. Finally, death steals on while some noble or pleasant thoughts play upon the features. We sometimes found our dead comrades a long distance away from the landmarks on the spots where they fell. This brings up a practical suggestion. Those who fall asleep peacefully die as we would have them if die they must. They usually, however, show unmistakably that they survived their

wound some little time, and the wound often seems trivial to have caused death. Since surgical aid to all is out of the question, why should not every soldier be his own surgeon? Suppose his pack contained a tourniquet, bandages, and lint, to the use of which he has been trained; also, a draught of some strong cordial which might sustain his own life or that of a comrade in extremities, until the relief corps should appear. A simple knowledge of the tourniquet, of bandages, and lint, and readiness to improvise substitutes, have saved countless lives. Lack of knowledge, sometimes, and sometimes an inexcusable lack of materials, have sacrificed thousands. A wounded soldier of our civil war stopped a severe hæmorrhage in the neck by clogging the artery with balls made of sand and blood-clot. He had nothing better at hand.

THE REVIVAL OF WITCHCRAFT.

By ERNEST HART.

I.

IN the byways of science, as on the scenes of a theatre and in the pages of fiction, an *alias* is often found to serve a very convenient purpose. But it is always a little disappointing, to those in search of a veritable novelty, to find in place of it only a discredited piece of antiquity, though varnished, polished, and faced with a new color; and it is not inspiriting, even to the *dilettante* of the drama or of fiction, to be put off with old and worn-out characters, masquerading under new names, with fantastic costumes and modern effects, however ingenious and startling.

The modern Athenians, who dignify themselves with the title of psychical researchers, have for some time been inviting us to the investigation of what they have led us to believe were altogether new departures into the domain of mental philosophy. A new horizon was opened out before us; methods of the communication of thought were described which set distance at naught, which dispensed with speech or gesture, touch, sight, or smell. Sensation, we were told, was transmissible without material expression; mental impressions could be conveyed by the unexpressed power of the will, character could be transferred by subtle and invisible channels into those whose morality required strengthening, or whose self-control needed bracing. All this has been indicated with some confidence, and with a careful and measured approximation to methods of rational inquiry, by some English observers whose competence in literature and some departments of physical

research were calculated to invite confidence. But it must be confessed that the results which they had obtained, and the very rudimentary evidence which they had adduced in this country, were far from sufficing to persuade any but a very select band of idealists that there was anything substantial either in their premises or their conclusions. For the last year or two, however, public attention has been invited to a series of phenomena which were seriously alleged to afford positive evidence of the existence of a variety of endowments of the human body, and of marvelous powers of mental action, which realized some of the promised wonders of "the new psychology." France was now, as in the last century, the chosen land of marvel. There appears to be something in the temperament of the Latin race which lends itself easily to neurotic disorder, to hysterical excitement, and to the production of startling displays of mental eccentricity. We have never been celebrated in this country, even in the middle ages, for our demoniacs, our dancing hysterics, or our miraculous cures. We have nothing to rival the ancient histories of St. Medard and Port Royal, or the modern pilgrimages of Lourdes. But if the modern hypnotists, psychists, and faith-curers are allowed the full play which has recently been given to them, in infecting the public mind with the follies of the "new hypnotism," the "profound hypnosis," the "new mesmerism," the "magnetization of hypnotics," and the "externalization of sensation," which they have been so solemnly propounding and so profusely describing in the pages of our leading newspapers and serials, we may yet see here an abundant harvest of mentally disordered and pathological creatures, such as have now for some years been permanently on show across the Channel; we may expect also to find our more solid literature poisoned with this evil influence, as our literature of romance and fiction already has been. From what I hear and know of the attractions which these false phenomena, these dangerous tricks, and this practice of mental subordination to another will, are already exercising on some ladies of the upper class in England and on some writers of influence, it appears high time that a thorough exposure should be made of the imposture and the self-deception which underlie the performances. Some of them have been rehearsed before eminent British journalists on their visits to Paris, and by them described in good faith, with no small literary power and considerable although imperfect detail, to the readers of the great English journals. The most vivid descriptions of the modern development of the new superstitions appeared in a series of articles in the Pall Mall Gazette early in last December, and in the Times at the end of December and the beginning of the present year. I was induced thereby to devote a fortnight at the end of the year to an investigation of the facts

described and the phenomena produced, and to an endeavor to find out how they were produced, and, as is always important in an inquiry of the sort, in what sort of people they took place. As a result I was able briefly to affirm in the columns of the Times that I found the whole series of performances to be based upon fraud, and that I had succeeded in reproducing the phenomena without employing any occult means or invoking any new powers of mind or body. This statement was welcomed by persons whose opinion I value, and by many of whom the articles in question had been read, as Prof. Tyndall writes, with "disfavor and indeed dismay." I am urged to lose no time in sweeping away this mass of rubbish, and "the disgusting superstitions" which these letters and publications have tended to promote. This I will attempt to do by stating in some detail precisely what the performances at the Charité are, and removing from them the halo of false science which has rendered them attractive and credible, and has to some extent obscured their demoralizing character. The business of demonstrating the marvels of the new hypnotism has been going on now for upward of twenty years, with very mischievous effects. It has culminated in performances of the patients of Dr. Luys in the wards of one of the greatest and most historically celebrated of the Paris hospitals. The Hospital of La Charité is a hospital with great traditions, dignified by great names, and still the seat of sound and able clinical instruction by a staff who must, I am sure, feel humiliated at finding the name of the great institution to which they belong becoming thus notorious throughout Europe for its connection with proceedings which they can but view with extreme disfavor.

In the first place, two patients were presented (who must be among the patients referred to), for they are and have been for some time the main subjects for demonstration at La Charité. One of these is a man named Mervel, an unhappy being of whom Dr. Luys promised to give me the clinical history, and of whom, briefly, it may be said that he has been all his life a wretched hysteric, subject to fits, to sleep-walking, and to catalepsy. He has passed through all the phases of this form of extreme nerve disorder. If he had been let alone, as he would have been in this country, or treated to a sound course of tonics, cold water (internally and externally), and field labor, he might have lived a more healthy life. He is now a miserable object, trained to all the tricks and the pathological aptitudes for simulation of a highly trained hypnotic, and on him were demonstrated phenomena which might indeed be "marvels" if they were not almost wholly frauds. I will run rapidly over a series of this man's performances as they were shown to me in the wards by Dr. Luys in the presence of observers, and I will presently add some of the other

performances of other patients and trained subjects of Dr. Luys who have differing aptitudes and a various *répertoire*. The man was brought in from the waiting-room and put in an arm-chair; a finger held up before his eyes sufficed to plunge him into induced sleep. This was clearly not simulated, and in a highly trained subject is exceedingly common. The eyelids were then lifted, and a little performance was gone through, which is described in the programme set out in Dr. Luys's Leçons Cliniques as the *prise du regard*. A finger is held before him; he gazes at it, sits bolt upright, and follows it as though fascinated around the room. This is, of course, a very ordinary performance, and is only, so to speak, the *lever de rideau*. He is taken back to his chair, and then begins the second performance. He is shown a magnetic bar, and here the true stage play begins, as it does in so many of these mesmeric performances, with the utterly irrelevant introduction of the apparatus of magnetism. He sees now from one pole of the magnet the "odic" effluvia, the blue flames, which are familiar to the readers of Reichenbach. He is delighted with them; he caresses the bar like a child with a toy; he follows it all over the place, and when the opposite pole of the magnet is presented to him, he is struck with horror at the red flames which issue from it, and shows every sign of fear and disgust. There are infinite variations of this marvel. Thus, a photograph of the poles of a magnet affects him in a similar way, no matter how old the photograph. On the face of Dr. Luys he sees red flames proceeding from the eyes and nostrils on one side of the face and blue flames on the other, which is supposed to coincide with the duality of the nerve-centers of the brain and the opposite polarity of the two sides of the body—puerile deductions which bear upon their face ignorant credulity, but which are supposed to derive evidential strength from these heightenings of the visual perception of this individual and the other performers of the same school. For these subjects quickly learn how to pretend to see the same thing; and Colonel de Rochas d'Aiglun, the *administrateur* of the Polytechnic School in Paris, whom Dr. Luys was good enough to introduce to me, has subjects who have made for him also a considerable series of drawings showing these flames playing about magnets and parts of magnets, surrounding crystals, and irradiating the features of himself and others. One patient has done me the honor of making my portrait with all its magnetic accompaniments. To the heightened visual perception of these ladies and gentlemen it seems that from one side of my face issues a sheet of lambent blue flame, and my eyes dart rays of blue fire; the other side is equally luminous with red flame, while down the middle of my face is a bright streak of yellow. Mervel drew this interesting picture, and the others confirmed it; and as this was done

in the wards of a hospital and by a patient in a state of "lucid somnambulism," and of good faith, I suppose I ought to have assumed that "there was no room for fraud or imposture." I ventured, however, to think otherwise. I took with me on the third occasion a magnet lent me by Dr. Johnson, of London, which had been thoroughly demagnetized by being thrust into the fire, and a series of steel pins which had been variously magnetized in inverse senses, and I found that the heightened senses of Mervel were quite incapable of distinguishing between the inert magnet, the variously magnetized needles, and the true magnet. I even placed the needles and the magnet in the hands of Dr. Luys and asked him to determine what Mervel saw. He saw always, in reply to Dr. Luys's questions, the orthodox thing. I then gently suggested to Dr. Luys that he should try some test experiments and use an electro-magnet, in which he could at will put on and take off the current and try for himself whether the patient did or did not really perceive what he described. I ventured to repeat the same suggestion when Mervel was describing the colored lights he saw around the poles of a faradic machine. My suggestions, however, were not favorably received; and Dr. Luys observed that he must be allowed to make his experiments in his own way. At these sittings Dr. Sajous, Dr. Lutaud, M. Cremière, of St. Petersburg, and others, were present. To end this part of the matter, I should state that I took successively three other subjects of demonstration whom Dr. Luys has presented to his classes, and tested still more decisively their pretended powers of distinguishing emanations from the north and south poles of the magnet and seeing the colored flames of Reichenbach. These subjects were a person named Jeanne, an accomplished impostor, and the most distinguished and highly trained of M. Luys's subjects, whose portrait occurs repeatedly in the illustrations of his lectures, and who describes herself as his *premier sujet;* a person named Clarice, whose marvelous powers are also much described in the publications of Dr. Luys; and a patient now in the wards named Marguerite. I tested these subjects repeatedly in the presence sometimes of the gentlemen above named, sometimes of Dr. Olivier, of Dr. Meurice, and of others whom I need not at present name. The results were that Mervel, whether sent to sleep by Dr. Luys, or by myself, or by the wardsman, was never really asleep to the extent of not being able to gather verbal and visual suggestions as to his course of action, as to what he ought to do and what he ought to see, and that his hysterical or hypnotic slumber did not prevent him from simultaneously carrying on a course of elaborate imposture. When I rapidly displaced the magnetic photographs of Dr. Luys or my own, he blundered over them, but immediately he understood that he was blundering he corrected

his mistake and saw what he ought to have seen. He was quite unable to distinguish an inert piece of iron from a true magnet, and unless he were guided by words let fall by the bystanders, or by the adoption of a systematic proceeding to which he was accustomed, he was quite at sea. Clarice and Jeanne, in their lucid somnambulistic state, never knew whether the current was on or off; unless they had a clew to the answers they ought to give, they were ludicrously wrong. They saw enormous flames issuing from the powerful magnet which I used. When I told the assistant to put on the current, acting on my previous instructions, he always did exactly the opposite of what I said, and they always fell into the trap. The culminating absurdity of this phase of the performance was the famous show for which this *clinique* has become famous, known as the magnetic skullcap, with its therapeutic and physical influences. "In this magnetic circlet," said Dr. Luys (speaking in the presence of his somnambulistic patient, who was supposed not to hear), "are stored up the thoughts and mental characteristics of an individual who suffered from melancholia and hallucinations of persecution. I will now put it on Mervel's head, and you will see what follows"; whereupon Mervel showed dramatic signs of the hallucination of persecution, suffering apparently great pain of mind and body. Possibly it was too cleverly acted to be wholly simulation, but it afforded a good example of the mixture of hysterical readiness to accept any suggestion with unlimited powers of deception; for this took place at the same sitting, and in the same state in which he pretended to see red flames and blue flames at random, accordingly as he supposed the magnet, or the photographs which I showed him, or the prints, or the pins, to be of the north pole or of the south pole. I repeated the experiment, always with the like results. Dr. Olivier, the editor of the Revue des Sciences Physiques, writes to me that the exposure was complete.

There was no correspondence between the phenomena manifested by the hypnotized person and the production of the current of magnetization, etc. You repeated the experiments of Dr. Luys and those of M. de Rochas, avoiding all suggestion, whether involuntary or unconscious, capable of vitiating the results, and you were careful to conceal from the subjects of experiment the moment at which the opening or the closing of the current of the magnet took place.

At any rate, therefore, we may exclude from the positive results which I attained in the presence of many witnesses the possibility of the electrical or magnetic current having any real relation whatever to the phenomena shown, and, as far as the utmost care could go, we may exclude also the influence of suggestion in any occult sense. Where the subjects thought they knew what was expected of them in their state of lucid somnambulism, they did it or saw it, whether I operated, or Dr. Luys, or his ward

assistant. Where they did not know they tried to guess, and with ludicrous results. Habitually they produced results exactly opposite to those which should have occurred, had the magnetic current had any influence whatever as a causal agent. I will now go further, and will affirm that there never was, any more than there now is, the slightest ground for believing that the most powerful magnets are capable of exercising any such influence as Dr. Luys and others are in the habit of assuming that they can exert over the animal organism. Opportunely enough, I find in the New York Medical Journal of the 31st of December a report of the experiments made by F. Peterson and A. E. Kennelly, with the most powerful magnets in the Edison laboratory, of which Mr. Kennelly is the chief electrician. Very powerful electro-magnets of 2,000 to 5,000 C. G. S. units to the square centimetre were employed. Not only was no visible effect produced in the polarization within the magnetic field of the hæmoglobin of blood, or in the circulation in the web of the frog's foot, but when a dog was placed for five hours under the influence of a magnetic field with an intensity of from 1,000 to 2,000 C. G. S. units to the square centimetre the dog was in no way affected and was very lively when liberated. A photograph is given of a boy sitting in a cylinder two feet in diameter and seven inches deep, upon which a set of field magnets converged: he was in no way affected. The next experiments were made by introducing the head into the field of a very powerful electro-magnet (2,000 C. G. S. units). The current could be turned on or off the coils of the electro-magnet without the knowledge of the subject. No effect on consciousness, sensation, circulation, respiration, or tendon reflex could be perceived. The subject was quite unable to say when the current was turned on or off. The last series of experiments were made with an electro-magnet in which the current was reversed two hundred and eighty times a second. No effect whatever was perceived when the head was introduced within the magnetic field of this potent instrument. The authors conclude that the human organism is in no wise appreciably affected by the most powerful magnets known to modern science; that neither direct nor reversed magnetism exerts any perceptible influence upon the iron contained in the blood, upon the circulation, upon ciliary or protoplasmic movements, upon sensory or motor nerves, or upon the brain. The authors further observe that they find it difficult to understand why magnetism appears to have no influence whatever upon the human organism. The experiments of like kind recorded by Sir William Thomson and in Pflüger's Archiv gave equally negative results.

The complete exposure which the results of my experiments effected of the valuelessness of the so-called magnetic effects on

the patients of Dr. Luys tallies with the negative results of Peterson and Kennelly, but it is perhaps too much to hope that it will put an end to the habitual exploitation of magnetic superstitions in this connection.

I come now to another series of phenomena which various eminent journalists have noted as illustrations of what the Times correspondent described as a perfectly genuine exhibition, and one which, as he said, in concluding his description of it, "proved that suggestions and impressions can be conveyed from one person to another by mere contact, and even across an intervening space." As he professes to be an impartial and guarded observer, I will quote his report, which, so far as some obvious occurrences are concerned, describes accurately what appears to go on in the extravagant folly which they have described so seriously, known as "l'envoûtement." This is a title taken from the practices of the middle ages, when the magicians of France and Italy exercised (as the magicians of the far East do now) their powers of sorcery upon a wax image, which, being duly endowed with mystical relationship to a human subject, was pinched, tortured, wasted, or destroyed, with corresponding results to the unhappy individual in whose effigy it was made. Here is the modern counterpart in the new mesmerism of which the modern historian gives the explanation which I have just quoted:

There remains, however, one set of recent experiments, which, from their novel and startling character, deserve special attention. I refer to the transference of sensibility from a hypnotic subject to inanimate objects. I have been fortunate enough to witness some of these experiments, and will describe what I saw. They were not carried out by Dr. Luys, but by an amateur who attends his *clinique*. This gentleman had a roughly constructed figure, about a foot high, resembling the human form, and made of gutta percha or some such material, and he experimented with it on a hysterical young woman, one of the hospital patients, and an extremely sensitive subject. She was placed in an arm-chair and hypnotized, and he seated himself immediately opposite in close contact with her, their legs touching, and her hands upon his knees. After some preliminary business of stroking her arms and so forth, he produced the figure and held it up in front of her, presumably to be charged with her magnetism, for these experiments rest on the magnetic theory. Then he placed it out of her sight and pinched it. Sometimes she appeared to feel it and sometimes she did not, but he was all the time in actual contact with her. Then he held it where she could see it, and this time she *obviously suffered acutely* whenever he touched the figure and in the place where he touched it, although she did not look at it or seem to observe it. Especially when he touched the sole of the foot, it *evidently tickled her beyond endurance*. Then the figure was placed aside on a table out of the sight both of the girl and of the operator, while another put one hand on the operator's back and the other on the image. I was in such a position as to see them all, and whenever the second gentleman touched the figure the girl felt it. Then she was told that she was to feel it just the same after being woke up, and an attempt was made to wake her, but she was by this time very profoundly affected, and the

statement was only partially successful. In this state—that is, still somnambulistic—she stood up and moved from her place, the operator did the same, and, being separated from her by some feet, he turned his back to her and held the figure in such a position that she could not possibly see it. Then he pinched at the back of the neck, and she felt it at the same moment, but at the wrong place. The place where she did feel it caused her some embarrassment, though harmless enough, as she informed him of the locality in a whisper, which I overheard. *I can answer for it that she felt something* at the moment when he touched the image, but that she could not see it and was not in contact with him, because I was standing almost between them. But she felt it far more acutely when he pinched his own wrist under the same circumstances. That brought the experiments to a conclusion. They occupied at least half an hour, and included a number of interesting details which I have been obliged to omit.

Thus his exhibition, which was "perfectly genuine," proved that suggestions and impressions can be "conveyed across space." The fact is that it did not prove the one any more than the other; and if the writer had instituted a few control experiments such as those which I forthwith carried out on the same subject, he would have saved himself from having been the medium of introducing thus impressively to the English reading public, through the pages of a great newspaper, a solemn description of what was easily proved to be a common imposture of a vulgar kind, by which the good faith and unquestionable sincerity and honor of the amateur of whom he speaks, and of Dr. Luys, had been surprised. There is no secret about the name of the amateur, for he has published much about the matter in great detail, with an abundance of highly technical and scientific nomenclature, and the performances had already been described, under his name, in the Pall Mall Gazette in this country, and in La Justice and L'Echo de Paris, and other journals in France. Colonel de Rochas d'Aiglun, who was the operator in this case in the ward of La Charité, gave a similar demonstration for my benefit at the invitation of Dr. Luys in the ward of La Charité in the presence of several witnesses. Subsequently he gave me and Dr. Sajous a like demonstration with fuller developments at the École Polytechnique, of which he is the *administrateur;* and I gave him a counter-demonstration in the rooms of Dr. Sajous before leaving Paris. To appreciate all the details of these performances one should read his book, entitled Les États profonds de l'Hypnose.*

To the subject, Madame Vix, being plunged into "profound hypnosis," as it was alleged, was handed a glass of water. To this she transferred by contact her sensitiveness; the atmosphere

* Les États profonds de l'Hypnose. Par le Lieutenant-Colonel de Rochas d'Aiglun, Administrateur de l'École Polytechnique. Paris: Chamuel, 29 Rue de Trévise; and G. Carré, 58 Rue St. André-des-Arts, 1892. See also Les Limites de l'Inconnu, by Georges Vitoux. Chamuel, 29 Rue de Trévise, Paris, 1892; and Le Figaro, January 10, 1893, p. 2.

surrounding her was also similarly charged with her sensibility; she herself becoming anæsthetic. When pinches were made in the air at given distances, which were supposed to represent points of contact and lines of cleavage of the atmospheric planes, such pinches at these given points were always felt by her and gave what is above described as "evident pain." I was shown drawings of these planes. When the water was removed to a distance and the glass was stroked or imaginary pinches made in the air just above the water, or the water itself was touched, she gave similar manifestations. This water, we were told, was charged with her vitality, and terrible consequences might ensue if the water were maltreated, either then or subsequently. Fantastic stories are related by Colonel de Rochas of the terrible effects following from the throwing away of this water and from people stepping on it, or from watering the flowers with it. In one case, where some one incautiously drank the water, the patient fell into a swoon which lasted for a fortnight. The only correct proceeding was to allow the subject herself to drink the water at the close of the *séance*, and thus enable her to protect herself from the sad effects which might follow any careless treatment of it. She herself was supposed to be insensitive while under operation, and her sensibilities were externalized and communicated to others either by "contact" directly to the operator, or in another hypnotized patient who was placed in contact with her, or, as the reporter solemnly describes, "across space." Whenever her magnetizer was touched she felt it in the same place.

Now, Madame Vix furnishes *séances* for a fixed consideration. On page 28 of his book on the profound stages of hypnosis, Colonel de Rochas refers to her as being a subject "well known in Paris," "very distinctly polarized," and "who passes with extreme regularity" through all the phases described at length in his first chapter, and, besides, "through some phases of an indeterminate character up to the point of syncope." She presented indeed, "when the left hand was placed on her head instead of the right, general paralysis so closely resembling death in appearance," that he did not dare to continue his experiments. She did the wax-image business, the state of sympathy by contact, and the rest, with such perfection before me under the manipulations of Colonel de Rochas at the Charité and at the Polytechnique School, that I asked her to favor me with some professional sittings, which she readily consented to do. She had an extensive *répertoire*, and on three separate occasions she went through her performances with great precision and completeness in the presence of a variety of witnesses, some of whose names I have already cited. I determined, however, to do everything *en faux*. On the first occasion I solemnly went through all the series of passes and

strokings and head pressure with the right hand, which Colonel de Rochas considers so essential, and we had all the correct successive stages of credulity (or *credivité*), of lethargy, catalepsy, again lethargy, somnambulism, lethargy, and *rapport*, and I then tested the statements of Colonel de Rochas. In the first place I found that in all the phases of the stage of *rapport* the subject perceived other objects and other persons quite as well as the individual, my humble self, who was supposed to be "the magnetizer." When any one pretended to be in contact with me, it had the same effect upon her as if he were really in contact, and it was evident that she guessed at what we were doing. Visions were as easily produced by pressure with the left hand as with the right, and, as to the seeing of colored odic flames from the magnet, she saw them "six yards long"; but, in fact, when proper tests were applied, she was found to be absolutely incapable of distinguishing a true magnet from a false one. She never knew whether the current was on or off my electro-magnet; and her whole performance in this respect, although she was not made aware of it, was so manifest and ludicrous an imposture that the bystanders had great difficulty in retaining their gravity. I tested now the phenomena to which the sham scientific terms of "externalization of sensation," "communication by contact," and "transference across space," are pretentiously applied. Behind a little pile of books on the writing table I concealed a tumbler containing some water. In duly solemn fashion I poured out from a carafe a little water into a similar glass and placed it in her hands. I then quickly substituted, without her perceiving it, the hidden glass of water, which she had neither seen nor touched. We had then a full-dress rehearsal of all the performances which I had previously witnessed. She showed the same "obvious" marks of pleasure or of pain when the water was caressed or pinched as were witnessed by the Times correspondent or the Pall Mall Gazette reporter. When one of the spectators was placed in imaginary contact with me, she became equally sensible of his actions; she writhed, she smiled, she was tickled, she was hurt, she was pleased, and she was "exhausted" in the orthodox manner. I now introduced the "wax figure." Skeptic as I was, but willing to be convinced, I had purchased two rather pretty little sailor dolls, twin brothers of the navy, at a neighboring toy shop. One of these she held until it was sufficiently "charged with her sensitiveness" by contact. I then rapidly substituted the twin doll from my pocket, and put away the sensitivized doll for future service. To make the performance quite regular, I cut off a minute lock of her hair and pretended to affix it to the doll. To this proceeding, which I had seen Colonel de Rochas gravely go through, she rather objected in her profound sleep, much to our quiet amusement. "C'est trop,

c'est trop," she murmured, apparently thinking that I was taking too much hair for the money. I need not say that I did not affix it to the head of the doll, although I went through the motions of doing so. I have now, and shall preserve, the two little doll "witnesses" and the valuable tress of hair as mementos of this interesting performance. It may take its place by the side of the famous tress cut from the locks of the spirit form of Katie King. We then produced, with the aid of the untouched doll, just unrolled from the tissue paper of the toy shop, all the phenomena of the *envoûtement* of the sorcerers, of which so much has been heard lately and which have figured so largely in the pages of the great newspapers of England and France. She felt acutely when its imaginary lock was touched and pulled, whether by myself or by Dr. Sajous, by M. Cremière, or by any one else in the room. She greatly resented its being pricked; she felt all sorts of indescribable and generalized heats and pains when the doll was touched in places of which she could not well make out the locality owing to our backs being turned to her, and she was duly suffocated when we pretended to sit down on the doll. I am ashamed to say that the real doll was lying there all the time, cruelly stabbed by me to the heart with a stout pin, of which she was unconscious. Its maltreatment, which ought theoretically to have been fatal to her, produced no visible effect. These performances she went through three times. On the third occasion Colonel de Rochas was himself present, and assisted to put her into a complete state of hypnosis, for by this time I had become a little indifferent to the stages of preliminary mummery, and, as there were three subjects on hand at the final sitting, I rather abbreviated the proceeding. Colonel de Rochas was a little astonished when I produced my toy-shop doll, clothed in woolen trousers and jacket, for demonstrating the *envoûtement;* but he explained that he was not so surprised as he should have been at an earlier date, for he had only that week observed that in a classic author, where these magical proceedings were described, it was noted that woolen stuff was a very good conductor; and he quoted a passage from a Latin author—of which I am sorry that I do not retain the exact recollection—in evidence of the fact that the woolen dress might prove an effective medium; otherwise, he observed, he should have been doubtful of securing good results, as the doll was of composition and not of wax. It did prove a very good conductor. In the course of the experiment, however, he skeptically tweaked the nose of the little composition doll face (of the doll which had not been "sensitivized"), and we had all of us the satisfaction of observing that the material made no difference to Madame Vix, and that the result was as perfectly satisfactory as if it had been made of real wax, for she immediately exclaimed

that somebody was pulling her nose, and resented it accordingly. At the close of this final *séance*, at which I had invited the presence of Colonel de Rochas, I explained to him the extent of the imposture, and showed him the false glass of water and the twin doll, the sham magnet, and the method which we had pursued in working the electro-magnet under a system of contradictory directions. I may venture to repeat that Colonel de Rochas acted in this, as throughout, as a gentleman of the most perfect good faith. He was duly and adequately impressed with this new order of facts. It is of course impossible to say what may be the conclusions at which he will ultimately arrive, but I understood him to incline to the vague belief that "it was all suggestion."—*Nineteenth Century.*

(To be continued.)

ADAPTATIONS OF SEEDS AND FRUITS.

By J. W. FOLSOM.

IF we consider the great variety of seeds and fruits, we naturally inquire its meaning; and if we are sufficiently interested to observe carefully the part which seeds play in Nature, we soon find that in innumerable ways they are adapted to their surroundings. On the seed, primarily, rests the all-important responsibility of perpetuating the species, and success or failure in this duty depends upon the manner in which the seed is adapted to encounter the dangers that threaten it.

The manifold adaptations of this kind which Nature exhibits have been brought about chiefly by natural selection, resulting from the co-operation of two laws: the law of heredity and the law of variation. Under the former, characteristics of a parent are transmitted to its offspring. In obedience to the latter, no offspring is exactly like its parent, but differs from it more or less. The variation being inherited by the succeeding generation will, if of favorable nature, tend to be perpetuated indefinitely. Contrarily, variation in an unfavorable direction will conduce to extermination of the species from the very nature of the case. Thus it follows that the accumulation of advantageous variations, however slight, and the necessary destruction of species possessing unfriendly characteristics, results in producing kinds well fitted for existence.

Bearing the above in mind as a general explanation, let us consider some of its effects as displayed in seeds and fruits.

We usually find seeds in a seed vessel of some sort, the whole affair constituting the "fruit." Common to all immature fruits is their necessity for protection, and this is met in various ways.

Winds which would break them off are effectually resisted by their strong yet flexible footstalks; and possible injury by bruising is averted by tough, elastic walls, often cushioned by prickles or other appendages.

Sudden changes of temperature, before they can penetrate to the unripe seeds, are rendered harmless by the blanketing effect of pulp or other material.

For protection from the animal world, immature fruits have developed a number of interesting devices. Almost universally "green" fruits so harmonize with surrounding color as readily to escape detection. In fact, the hazelnut is enveloped in a leafy coat which renders it very inconspicuous. The nutritious albumen of the seed is often fortified by such impenetrable shells as those of the cocoanut and others. Perhaps there is a formidable armament of prickles, as in the chestnut; or of stinging hairs, as is the case with some pods. Characteristic of immature fruits are disagreeable taste and consistence. Compare an unripe peach, sour and stringy, with the same fruit in its luscious maturity.

But all these contrivances fail to repel certain enemies of growing fruits. The apple's inconspicuousness, toughness, and sourness are of little avail against the young progeny of the genus *Homo*.

In many remarkable instances plants by their movements are able to protect their precious seeds from injury. In our common fall dandelion the whole flower closes up while the seeds are ripening, but reopens at their maturity. Furthermore, the upright flower stalk sinks to the ground when the flowers fade, but erects itself again when the seeds are ready to be scattered by the wind. In one of our winter house plants, the common cyclamen, the flower stalk coils up after flowering, bringing the pod to the ground to ripen; and our sweet white water lily, after expanding and withering above water, sinks to mature its seeds in safety. Other more remarkable but less common cases might be cited to show the extreme care with which plants preserve their seeds from possible destruction.

At maturity the one object of the seed is to secure the advantages of wide dispersion, and to effect this purpose Nature uses all means at hand. The agencies against which she so lately contrived are now most sedulously sought, and almost endless are the modifications of structure which enable seeds to spread far and wide.

"Dehiscence," the splitting open of a ripe pod, is manifestly a provision for seed dispersion. In its simplest form dehiscence merely exposes seeds to various conveying agencies: to the wind, in the milkweed; to birds, in the case of some brightly colored beans. Other plants, however, do more than this. Our wild

columbine is particularly well adapted for having its seeds scattered by the wind. They are held in open seed vessels surmounting a slender stalk which, although nodding at flowering time, has become upright. A slight breeze easily shakes this stalk, causing the seeds to be thrown for quite a distance. The poppy throws its seeds in a similar way, and the little eaves which stand over the holes in the pod are even said to close in wet weather, not allowing the seeds to escape.

In many wonderful instances the ripe pod projects its seeds forcibly into the air. In some of our wild violets the pod, after dehiscence, consists of three spreading valves, each shaped like a boat, bearing within several seeds which are pear-shaped, hard, and smooth. In drying, the valve walls contract, approach each other, and squeeze out the seeds, which are thus thrown several feet. Our wild witch-hazel throws its seeds often to the distance of thirty feet. Many of us recollect the sudden bursting and coiling up of the pods of the "touch-me-not," whose yellowish, spurred flowers are so common in moist places. The object of this action is to expel the seeds. Curious is the case of the squirting cucumber of southern Europe. The ripe, cucumber-like fruit is greatly distended by its contents. At a slight touch, as from a browsing animal, it breaks from the stalk, and through the hole thus formed the pressure of the elastic walls forces the seeds in a viscid liquid for twenty or thirty feet.

Fruits that do not split open are invariably scattered by external means, inanimate and animate. Of inanimate agencies the wind is far oftenest employed, and seeds have evidently found it extremely efficient, judging from their many adaptations for wind dispersion. The seeds of our elms, maples, pines, etc., are surrounded, as we know, by thin expansions called "wings," whose purpose plainly is to present a large surface for the wind to act upon. Wings are characteristic alone of trees or tall shrubs, and never occur on low herbs, where they would clearly be out of place. Instead of a wing, a tuft of hairs frequently serves the same purpose. A common example is furnished by the milkweed, whose seed is surrounded by a spreading "pappus" of long, silky hairs. The dandelions and thistles have adopted this means of distribution, and this explains their abundance everywhere. In the smoke-bush of our gardens only a few flower stalks bear fruit, the rest become slender and feathery, forming a light network which is borne along in the wind, carrying the few small fruits which have formed.

Flowing water transports many large nuts, some depending upon it almost exclusively. Drifting along in our fresh-water streams one may often see the "key fruits" of the red maple, and the soaking they thus receive must further germination. The

prevalence on our river banks of oaks, hickories, and maples is also very noticeable. Again, ocean currents are of great importance in distributing plants. The cocoanut, buoyed by its loose husk and protected by an impenetrable shell, floats in the sea until it is brought often to some coral island where it may grow. Many small seeds are also conveyed by ocean currents, and it is very probable that they retain their vitality, for Mr. Darwin has recorded some interesting experiments showing that a good proportion of seeds can withstand injury from salt water for a considerable length of time. The action of freezing water, as manifested in frost, has the well-known effect of freeing nuts from their protecting envelopes; and frozen water, in the shape of glaciers and icebergs, is of a little importance in transporting seeds. It is possible that during the Glacial period seeds were conveyed from place to place incased in ice.

Of all devices for dispersion the most remarkable are those by which the aid of animals is secured, and this aid is so valuable that plants spare no expense to obtain it. Usually animals are well paid for their services, but many plants, however, do not hesitate to deceive their benefactors by all sorts of trickery. This latter class, though, has not been nearly as successful as the others in the struggle for existence.

It is now well known that what are popularly called "fruits" exist for the mutual benefit of plants and the lower animals—not for man. And it is generally believed that these fruits have developed their attractive qualities through natural selection. The results reached by man in selecting and propagating the best varieties of fruits are the strongest grounds for thinking that these fruits were once evolved from very crude conditions through similar selection by the lower animals, particularly birds. Such fruits, for instance, as by natural variation became at all agreeable to birds would be sought out by them, to the exclusion of less attractive fruits. In consequence, the favored fruits would stand better chances of setting seeds than would their less favored companions. Variations being transmitted from parent to offspring, it is reasonable to suppose that favorable variations would become still more favorable by further selection, until, by the accumulation of even slight variations through geologic ages, there would result fruits highly attractive to certain animals by their color, perfume, and taste. In the mean time, fruits possessing unfavorable characteristics have for this very reason been exterminated, or else have attained a less degree of success than the others.

Insects are the lowest animals known to assist in seed dissemination. Mr. Darwin tells us of locust excrement containing seeds which grew when planted. Considering that locusts often

occur in vast swarms, they can hardly fail to be highly effective agents in seed dissemination, thus repaying to some extent for the immense damage they often do.

Fishes are known to swallow seeds of many kinds, and must transport them from place to place; but the value of fishes as seed conveyers is hard to estimate.

We have just said that our edible fruits are really contrivances for securing seed dissemination, especially through the agency of birds. Take, for example, some of our common fruits —the currant, grape, plum, peach, apple, etc. All these are constructed with this end in view. When ripe, they are colored brightly to attract animals; some possess agreeable odors, and most have a delicious taste and consistence. In short, they are highly adapted to become the food of animals. While swallowing such food animals can hardly help swallowing seeds as well, and such seeds are finally emitted under conditions admirably conducive to germination. Why our most delicious fruits are often offset by their disagreeable seeds may have occurred to many of us. The fact is, by this means seeds are protected from possible injury in the alimentary canals of animals. Take, for example, the small, hard seeds of the grape or fig, and the similar so-called seeds of the strawberry, blackberry, and others. Far from being destroyed by the digestive juices, the seeds are probably facilitated in their germination by the warmth and moisture received.

The rapid ripening of fruits doubtless prevents their premature destruction. The accompanying change in color is remarkable. Whereas young fruits harmonize completely with surrounding color, mature fruits are extremely conspicuous. Recall the barberry, rose, sumach, mountain ash, and many more. In some honeysuckles each cluster of scarlet berries stands in violent contrast against a green leaf. In the blackberry lily of our gardens the sides of the pod roll back and display their white linings, conspicuously relieving the black, berry-like seeds. The burning-bush is a brilliant example with its flaming scarlet. In the West Indies is a plant whose pods are red within, containing seeds that are blue. Other instances might be named, but they are indefinitely numerous and easily observed by any one.

Many of our fruits are covered with a waxy "bloom" as it is called. This is plainly a protection, for it is commonly known that fruits will long resist decay provided this coating is uninjured. Its probable effect is to resist decomposition by moisture and fungi.

The edible portion, however, is of most interest to us, not only scientifically, but also in a practical way. How highly it is esteemed by some animals may be judged from the expense we often incur in buying fruits out of season.

The use of poisonous fruits is an interesting subject for consideration. How is a plant benefited by producing them?

Mr. Grant Allen suggests with regard to a near relative of our Jack-in-the-pulpit that its brilliant scarlet berries are readily detected and eaten by birds; that such birds are consequently poisoned, and by decaying provide abundant nourishment for the germinating seeds. He adds that birds can not profit by experience and avoid the berries, as no bird ever lives to tell the tale.

At first this explanation seems very reasonable, and perhaps it is; but we have reason for doubting it, for we find that many fruits poisonous to mammals are eaten by birds without the slightest injury. The beautiful apple-like manchineel, which is most virulently poisonous, is eaten by tropical birds with the greatest impunity.

On the whole it seems very likely that some fruits are fatal to other animals but not to birds, and under all explanations poisons are doubtless a protection, at least, to the fruits which possess them.

Many fruits have been so highly cultivated by man that they can no longer set their seeds as originally. Our wild red cherry is a convenient morsel for even small birds; but its highly cultured relatives of the garden must submit their flesh to birds who can not eat stones as well. The case of the strawberry is different, however, for birds can scarcely take a morsel that does not contain numbers of the small, hard "straws," which are really the most essential parts of the plant, for each one incloses a seed.

In many cases Nature economically develops as little sweet pulp as will serve her purpose. In the wild red cherry, for instance, the stone occupies almost the entire fruit, there being only a thin layer of food substance. Often there is none whatever, and instead the fruit attains its ends by simulated attractiveness. The rosary bean temptingly displays its brilliant red seeds, which are in reality of stony hardness. Yet it does not wholly rely upon this artifice, for it is very probable that part of the seeds are scattered by the twisting dehiscence of the tough pod.

In some instances the deception is really wonderful. Some pods and seeds mimic insects so closely as probably to entice insectivorous birds to carry them, at least until the birds find out their mistake. It may be also that this appearance protects them from graminivorous birds. There are pods which curiously resemble worms and spiders and caterpillars. Our common castor-oil bean bears a superficial likeness to a beetle. Yet there are some most remarkable cases of mimicry where beetles are counterfeited in the minutest detail.

Fruits are also disseminated by mammals as well as birds.

Berries are the favorite food of many of our native mammals, the woodchuck and others. Wild apples are frequently carried off by squirrels, and it is well known that squirrels store up large quantities of nuts which oftentimes are never eaten. Fruits too large to be swallowed by most birds are easily devoured by the larger mammals, the apple, for instance, whose seeds are protected by tight husks well adapted to slip through the alimentary canal of an animal without receiving the least injury.

The gourd fruits, so much liked by man here, are equally attractive to his quadrumanal brothers in the tropics.

For utilizing the services particularly of mammals many fruits have developed hooks or horns to catch in the fleece of passing creatures, who thus transport the seeds from place to place. An autumn tramp through our pastures will soon convince one of the efficiency of this mode of dissemination.

A very familiar example of this kind we find in the common burdock; but the hooks of the burdock are insignificant affairs compared with some which exist. In the Southern States grows a fruit, *Martynia proboscidea*, having two recurving horns several inches long. The appearance of the fruit would justify its having an even more formidable name. Another fruit, *Harpagophyton* by name, is a bristling mass of powerful hooks. It is said that lions trying to free themselves from its clutches get it into the mouth and die in torture. Instead of hooks, seeds sometimes effect the same purpose by being sticky.

It is a suggestive fact that hooked fruits occur on low plants, never on trees; also that in geologic time hooks appeared simultaneously with land mammals.

Lastly, we must recollect that man himself disseminates seeds in a thousand ways. War often introduces new plants into a region. Commerce is of vast importance in this respect. In the vicinity of our woolen mills a strange flora, from seeds introduced with the raw wool, is struggling with native plants. Agriculture is certainly of unbounded effect in the way we are considering. In short, human will has almost limitless control over the circumstances of plant life.

After dispersion most seeds simply rest on the ground to await germination, perhaps protected by color resemblance, as in nuts, or by mimicry, sometimes mimicking a dry twig to perfection. Some seeds, though, do more than this. The parasitic seeds of the mistletoe, dropped by birds on the boughs of trees, would soon fall to the ground and die were they were not very sticky. The seed of *Mysodendron* has three long, flexible appendages which twine round any suitable branch to which it is blown.

There are a few seeds which literally corkscrew themselves into the ground. One of our natives—*Erodium*, or cranesbill—has

seeds which are small, pointed, and covered with hairs. The posterior end is prolonged into a hairy, corkscrew-like awn, which twists or untwists, according to the amount of moisture. This awn ends in a feather-like affair with backward-pointed hairs. On moist ground the seed-hairs stand out so as to place the seed-point downward, and the awn untwists; but the barbed feather preventing upward movement, because it catches in the herbage, the seed is forced into the soil. However, if the awn dries and contracts, the feather is easily drawn down while the seed is not drawn up. By successive moistenings and dryings the seed is ultimately driven completely into the earth.

As to vitality, seeds present widest differences. Very short-lived seeds are those of the coffee and magnolia. On the other hand, under abnormal conditions, some seeds have retained vitality for many centuries, apparently. Raspberry seeds, found in a Celtic tumulus along with coins of the Emperor Hadrian, germinated, according to good authority, after a possible interval of several centuries. Other seeds from old Roman tombs grew after a lapse of many hundred years, but these are exceptional instances. Accurate experiments show that a few kinds live for fifteen years, or thereabouts, while the majority are much shorter lived. Stories of wheat raised from seed found in mummy wrappings are founded upon no trustworthy evidence whatever.

When a forest has been removed by fire, or otherwise, it commonly happens that a fresh growth of entirely new plants immediately springs up. This may be partly due to the unusual opportunity for growth thus given to foreign seeds; but the usually accepted explanation is that the new growth is from seeds which have long lain dormant.

Finally, as regards germination, seeds accommodate themselves to surrounding conditions with considerable readiness. Some seeds are so tenacious of life as to germinate, not only when old, but also when a large share of their food substance has been destroyed, provided, of course, that the germ itself is uninjured. No seed, however, will germinate without the proper amount of moisture, free oxygen, and warmth, although other disadvantages are often withstood successfully.

We have now described some of the more evident adaptations to surroundings displayed in seeds and fruits, but by no means all; for here, as everywhere else, Nature presents a variety which is almost infinite. Although endless differences in structure are still unexplained, we must believe that they are adaptations to circumstances present or past, and our knowledge leads us confidently to expect that future discovery will reveal in increased vastness the complexity of the relations by which everything in Nature is adapted, more or less perfectly, to everything else.

WHY GROW OLD?

By Dr. N. E. YORKE-DAVIES.

IT may seem a curious assertion to make, but it is nevertheless an absolutely true one, namely, that a man's life is not measured by the years that he has lived, but by the way in which he has spent them. Many a person may be as young and active at seventy as another at twenty-five, and the length of his life, his health, and his ability to enjoy green old age, depend in a great measure on what the surroundings have been in the earlier years of existence. It is perfectly true that every one may not be born with a strong and healthy constitution. There are certain constitutional defects that are hereditary in certain families, and these under certain circumstances may influence length of life. For instance, we may inherit the scrofulous taint and fall victims, if not careful, in early life to consumption. We may inherit the gouty taint, and be subject to all the ills that this disease entails in middle age in those who do not learn how to diet themselves. We may be born of families in whom the tendency to obesity is more than usually developed, and this in advancing life may be a serious drawback to comfort, and will undoubtedly tend to shorten existence. But all these weaknesses and idiosyncrasies of inherited constitution may be wonderfully improved, and even, eventually, entirely remedied, if in early life proper care in regard to exercise, food, fresh air, and those surroundings which tend to strengthen the system and improve constitutional stamina, are made a part of the daily routine.

A boy or a girl should be trained to indulge in athletic exercises of some kind, so that the habit of taking exercise may become established, and this, once acquired, is seldom neglected even as years advance. The boy who is fond of football, cricket, tennis, and other athletic games will, from the simple love of emulation, always keep up his muscular and nervous strength, and this will stand him in good stead in middle age, and even in a greater degree in old age.

In a former article in this magazine I gave some statistics with regard to the after career of university men, and those statistics proved that their lives were longer than those of others who in college life were of a more sedentary habit. That is, they lived and are living to beyond the average duration of life at any given age. Some who have come to me of late, to remedy by dietetic means—the only means I adopt—the tendency to obesity or gout, have been fine specimens of physique.

We all know that a seed planted, whether it be a grain of wheat or an acorn, depends for its proper development upon care-

ful manuring and proper attention in its early existence, as to whether it becomes a strong plant or dies in its infancy. If it is planted in congenial soil, and is properly watered and cared for, it will live and grow luxuriantly; but if in improper soil, and left to take care of itself, it will possibly soon die. It is the same with a human being, and however weakly it may be as an infant, if it is properly nursed and taken care of, the foundation is often laid of a mature and sound constitution.

The law of the survival of the fittest may, in some instances, be a cruel one; but it is a beneficent one, for it does not seem right that those entering the world should be handicapped with the weaknesses of their ancestors, and those who have the well-being of the race at heart hold the opinion that constitutions that inherit any strongly marked hereditary weakness should not be allowed to contract obligations that may and will entail suffering upon a future generation.

We do not attempt to rear plants and flowers from imperfect specimens, nor does the agriculturist breed his stock from any but the best and healthiest in any class that he may wish to propagate, and surely the same amount of care and selection should be used with regard to our own species. In the higher ranks of life we see better specimens of the English race than in the lower ones, for more care is exercised in this respect. Something more, of course, must be allowed for this greater care and attention bestowed up to adolescence. Whereas it is estimated that out of every million people born, only ninety thousand reach the age of eighty, eleven thousand that of ninety, and two thousand the age of ninety-five—really, treble that number should reach these respective ages; in fact, if all the surroundings of life in every way were as they should be, there is no reason why six times the number should not reach these ages.

Much of the comfort of middle and old age depends upon early training and early feeding, and I refer here more particularly to school life. Neither mind nor body should be *forced*. While the intellectual faculties are being trained, the bodily requirements should be attended to. The constitution is being built up during the years that a boy is being educated for his pursuits in after life. I can remember my own life at a well-known school in a fashionable town five-and-thirty years ago, and I often wonder I survived it when I recall many circumstances. No proper care was taken of us; hunger, thirst, badly cooked meat and vegetables, sanitary defects, were the rule. Many a time, hungry as a schoolboy should be, have I had put before me for dinner meat that was scarcely warmed outside, and this or nothing had to be my meal. Had it not been for an old man who used to come to the playground selling buns and cakes, I do not know how at

times we should have endured the pangs of hunger, or subsisted on the scanty fare allowed, even had it been properly cooked, which it seldom was. Fortunately, nowadays, I believe, the *cuisine* in public schools is much improved, and more care is taken that growing boys should have a sufficiency of those foods that lay the foundations of a sound constitution in after life. A parent would do well, before sending his progeny to school, to see that the ventilation of the rooms, the sanitary arrangements of the school, and the diet and the capabilities for gymnastics and outdoor exercise are adequate. These things are of as much, if not of more, importance than the knowledge of Greek and dead languages, etc. There is every reason why, while the intellectual faculties are being trained, proper care should be taken of the material part; in fact, a boy's mind can not be stored with information which may be useful to him in after life and the health maintained at a standard to resist disease, if, at the same time, the brain is not fed by proper food, and the constitutional stamina kept up by exercise and fresh air.

There are some diseases due to carelessness in early life that leave traces that may handicap their possessor throughout existence, and possibly the worst of all is rheumatic fever. In this case, mischief may be done to the heart that can never be remedied, and therefore it is necessary in the days of adolescence, when the individual is careless of consequences, that a boy or a girl should be properly clad, and more especially that the covering next the skin should be flannel. The tendency that rapid changes of temperature have to induce this disease where an individual inherits the gouty and rheumatic diathesis, should make its prevention a matter of great importance, and much may be done by forethought and care to obviate the risk. Another result of school life that may bear bitter fruit in after life, that never seems to have attracted the attention it should do, is that the weak and the strong are allotted the same amount of intellectual work. This should not be. "The wind should be tempered to the shorn lamb," and the amount of intellectual work of each boy should bear some proportion to his physical and mental power.

Of course, it would be useless to expect the young to apply to themselves rules that bear fruit when they get to middle and old age. They are too young to have forethought and to understand that, like a bottle of new port, they ought to carefully mature, so as to improve as time goes on. It is a melancholy circumstance, as I have seen even recently, a lad, unfortunately left with boundless wealth and a great name, beginning life at seventeen years of age, and becoming a prematurely old man at twenty-four, and there are few medical men of large experience who can not recall numerous instances of men who have overdrawn their con-

stitutional bank before the age of twenty to such an extent that the account can never be placed on the right side on this side the grave.

If I were asked what factors would conduce to green old age, and the ability to enjoy life to past the eighties, I should say it was a matter of plenty of good food, fresh air, and exercise in early life. But, alas! how few people take the trouble to consider for one moment what food would be most suitable for their particular requirements, or the requirements of their children, at a time when this is all-important! We can not put old heads on young shoulders, but we can suggest to those who have young lives in their charge that they have a serious trust, and what their duty is in this respect.

We know that meat and bread furnish all that is necessary to sustain life, but, of course, we do not live on meat and bread alone. The ordinary living is made up of thousands of different articles in daily use. Still, there are certain rules that particularly apply in this way, that certain constitutions require a larger proportion of one particular class of food than other constitutions, and the man who does a large amount of physical labor requires a different mode of dieting from one who is sedentary. It would be impossible to enter into a subject of this kind at length in a short article. Diet, however, undoubtedly has much to do with long life, and this more especially applies in its application to the particular calling of each individual. The engine of an express train is coaled differently from that of a slow one. A race-horse is fed and exercised differently from a cart-horse, etc.

A man brought up in an active occupation that entails a certain amount of muscular exercise can take an amount of food that a man of sedentary habits would not stand, and therefore a certain difference should be made in the composition of the diet taken by the two. Food is simply fuel, and in a general way answers the same purpose.

As Dr. B. W. Richardson, in his interesting work, Diseases of Modern Life, observes: "The English middle class, who may be exhibited as types of comfortable people, moderately provided for, take on an average twelve ounces of mixed solid food for breakfast, twelve ounces for midday meal, or luncheon, and from twenty to thirty ounces for their late modern dinner or ancient supper. A total of from forty-five to fifty ounces of solid sustenance is in fact taken, to which is added from fifty to sixty ounces of fluid in the way of tea, coffee, water, beer, wine. This excess is at least double the quantity required for the sustainment of their mental and bodily labor."

He then gives a good illustration of this, and says: "I was once consulted in respect to the symptoms with which the idle in-

mates of a large and wealthy establishment suffered. I was told that an affection very much like dysentery had become developed, and was unusually obstinate of cure. The water supply of the establishment, the drainage, the ventilation, had all in turn been blamed, and altered to no effect. I found the unfortunate sufferers were sitting down regularly to four heavy meals a day, with animal food at each meal; that they took between meals no exercise adequate for utilizing a little of the potential energy that was stowed up in their tightly packed organisms.

"This one fact seemed to me sufficient to account for the phenomenon, and the instant relief that followed the cruel prescription of 'double the work and halve the food' was proof direct that the process of cure was immediate."

This quotation I reproduce as illustrating what I have pointed out, that the amount of food should be adapted to the requirements of the system, and to the amount of physical or intellectual work done, if it is not to be harmful in some way. If these individuals had been huntsmen or whippers-in to a pack of hounds, the food would probably have been just sufficient for the requirements of the system. If we want to see good illustrations of green old age, we must look for it in men who are noted for their physical and intellectual vigor; and a man who takes active exercise, whether in cutting down trees or in brisk walking and other physical pursuits, and in addition to this does plenty of brain work, lives carefully, and drinks but very moderately, may, long after he is an octogenarian, control the destinies of a mighty nation, and give indications of mental and bodily vigor that would shame many half his age. The wiry frame of such a man will be vigorous when the obese and sedentary individual of the same age has drifted into senility and second childhood.

There is no more fatal barrier to long life than obtains in the case of a man who has until middle age been used to active occupation, and been employed in business pursuits that have engrossed his time and energies, and then suddenly retires to a life of ease, luxury, and enjoyment. The revulsion that such a change entails seems to throw the whole human machine out of gear. The surroundings in the way of diet and exercise are seldom considered and adapted to the altered circumstances, and the result is that the different organs that looked to the stimulation of active occupation to keep them in working order, become clogged with waste; and those diseases that depend upon such a state of affairs, such as congested liver, indigestion, obesity, gout, bronchial troubles, etc., soon manifest themselves. Does not this equally apply to any piece of mechanism? Even take a clock, for instance; if dust, rust, and dirt are allowed to accumulate in its working parts, how soon (be its steel ever so highly tempered) does the friction

of adventitious matter throw its harmony of movement out of order!

Work of some kind or another seems essential to the well-being of the human organism. Even a machine keeps in better order when it is worked, looked after, and oiled, than when it is neglected and allowed to rust. Up to middle age persons may indulge in any amount of hard physical exercise—that is, if they are wiry and of proper physical proportion; but if a tendency to corpulency supervenes, certain changes in the blood-vessels and other organs, on whose healthy action robust health depends, take place. These become weakened and altered in texture, so that any attempt at undue exercise is attended with a certain amount of risk. Hence, any one who wishes to live to old age, and enjoy it, should look with anxiety at the first indication of corpulency. How many patients have consulted me to whom I have pointed out personally, or by correspondence, that they have carried for years an unnecessary burden in the way of surplus weight; and after, by proper dietic treatment, they have been relieved of it, with improvement in health and condition, they have regretted that for so many years they should have been weighted with a useless and uncomfortable load.

Of course, the tendency to corpulency is a very common one, and I know of no condition that tends to shorten life and to make it more of a misery, especially as years advance. The extra work of carrying unnecessary fat entailed on the heart alone is quite sufficient to shorten life; but, worse than this even, it lays the system more open to congestive diseases, and less able to bear treatment for their cure. It is the greatest bar to enjoyable old age. I suppose my experience of this condition is exceptional, as I devote the whole of my professional time to remedying it and a few other diseases of malnutrition, by a system of scientific dieting now well known. As this condition is the result of taking certain foods in undue proportions, its remedy lies in properly apportioning these; and as soon as those who unduly increase in weight are taught what the injurious ingredients of their daily diet are, and advised to curtail them for a time, the result is that they lose unnecessary tissue rapidly and safely, with improvement in every way.

For a month or two the daily intake of food and its constituents must be carefully adjusted. No purgative or other medicine is necessary for the purpose; indeed, violent purgative medicines are absolutely injurious, as they simply wash the food through, without giving it time to nourish the system, and debility, palpitation of the heart, and loss of condition result. Of course, a little mild aperient, in the shape of some natural mineral water, such as the Franz Josef, is always harmless, and most people,

from errors in diet, require something of this kind occasionally. Electrical appliances and electric baths are quite useless as fat-reducing agents. Quack remedies of all descriptions should be avoided like poison; if they reduce weight they do it at the expense of health. Of this I have seen repeated examples, and this induces me more particularly to make these observations.

The meager diet and quantity of water drunk at some of the spas abroad, of course, clears the system of waste; but this is only a temporary benefit, as the individual is not taught what little alteration he should permanently make in his diet. He comes home to his luxurious surroundings, and rapidly recharges the system with fat, gout poison, and other injurious products that form the elements of certain food which he takes in too great excess.

Exercise, proper selection in diet, and a little abstinence are better means of warding off an attack of gout than all the spas in existence, and the symptoms of an impending attack are well known to sufferers. As soon as the system is overcharged with the poison, an acute attack comes on. How much better to prevent the system being charged at all with an unnecessary poison, and this is only to be done by a proper selection in diet! Hard-worked laborers and the poor never suffer from gout, and the Scotch are entirely free. It is a disease of overfeeding—more especially in certain articles of food and drink—and underworking, and entails on its victim much misery, if not worse, and his progeny inherit the curse for generations after.

The evils that arise from errors in diet are properly remedied by diet. An excess of fat invariably depends upon the individual indulging to too great an extent in sweets and farinaceous food, and in not taking sufficient exercise to work it off. The surplus in such a case becomes stored in the system as fat, and can easily, as previously pointed out, be got rid of by a properly constructed dietary. This may be very liberal indeed, but all fat-forming ingredients must be carefully cut off. I have known twenty-five pounds of fat lost in a month by dietetic means alone, with vast improvement in the general health and condition. Indeed, a loss of surplus fat always means a great improvement in condition as well as in activity and vigor.*

Different constitutions have peculiarities in regard to the way in which they assimilate food, and the old adage that what is one man's meat is another's poison is a very true one. There is no ailment more common in middle life and in old age than indigestion. This, of course, depends upon improper food taken too frequently

* See Foods for the Fat: the Dietetic Cure of Corpulency, by Dr. Yorke-Davies. London: Chatto & Windus.

and in undue quantity. As a rule, the victim of indigestion flies to medicines for relief, or to one of the thousand-and-one quack remedies that are advertised to cure everything.

How much more rational would it not be to alter the diet, and to give the stomach the food for which it is craving! If the stomach could talk, I can imagine it, after pills, and gin and bitters, and quack remedies of every description have been poured into it, begging to be relieved of such horrors, and saying, "Give me a little rest, and a cup of beef tea and a biscuit, and go and take a little fresh air and exercise yourself." Instead of this, the miserable organ has to be dosed with all sorts of horrible concoctions in the way of drugs, brandies and sodas, and champagne, to endeavor to stimulate it into action. There is no doubt that the stomach that requires stimulants and potions to enable it to act efficiently, can hardly be said to be in a healthy state, or can long continue to do its work properly.

The digestive organs, unfortunately, are the first to sympathize with any mental worry. They are like a barometer, and indicate the errors of malnutrition and their consequences. The healthy action of every organ depends upon the proper assimilation of the food taken. As soon as the digestive process fails, everything fails, and ill-health results with all its disastrous concomitants.

Indigestion is more particularly the ailment of those engaged in sedentary pursuits, and if a person who is frequently the victim of it would, instead of flying to drugs, try such a diet as the following for a few days, he would not regret doing so. At least, this is my experience:

He should begin the day at 7 A. M. with a tumbler of milk and soda water, or a cup of Liebig's beef tea, or of bovril. At half past seven he should take a tepid or cold sponge bath and rub the skin thoroughly with a coarse towel or, better still, before the bath, with a massage rubber. At half past eight for his breakfast, one or two cups of weak tea, with a little milk and no sugar. A little stale bread or dry toast. A grilled sole or whiting, or the lean of an underdone mutton chop, or a newly laid egg lightly boiled. For luncheon at one, a few oysters and a cut of a loin of mutton, some chicken or game, or any other light digestible meat. A little stale bread and a glass of dry sherry or moselle. Such a one should avoid afternoon tea as he would poison, and at six or seven have his dinner, which should consist of plainly cooked fish, mutton, venison, chicken, grouse, partridge, hare, pheasant, tripe boiled in milk, sweetbread, lamb, roast beef, and stale bread. French beans, cauliflower, asparagus, vegetable marrow, or sea kale, may be used as vegetable, and half a wineglassful of cognac in water may be drunk. If he takes wine, one or two glasses of

dry sherry after dinner, and before retiring to bed a cup of Liebig's beef tea and a biscuit may be taken.

During the day brisk walking exercise to an extent short of fatigue should be indulged in, or riding or cycling, as the case may be.

Such an individual in a few days would find himself a different person. Slight ailments of this kind, and errors of malnutrition, are much better treated by diet than by medicine. Of course, there are certain habits that are not conducive to long life, such as immoderate indulgence in the passions, whatever they may be, and the abuse of alcohol. There is no reason why a man should not enjoy, in moderation, all the good things of this life, and really the enjoyment of them means taking them in moderation. The man who enjoys wine is the man who takes just sufficient to do him good, and the man who drinks wine to excess, and suffers the next morning from headache as a consequence, can not be said to do so. Excess in alcoholic stimulants in early life means sowing seeds that will bear bitter fruit in mature age —if the individual lives to see it. The habit of "nipping" is conducive to shortening life more than any other habit. It stimulates the different organs of the body into unnatural activity, and the result is that certain of them, such as the liver and the heart, by the work thrown upon them, become, through the enlargement and engorgement of their tissues with blood, diseased after a time. This leads to their being useless as organs of elimination or of healthy structure, with the result that, when middle age is just over, the individual becomes prone to such complaints as Bright's disease, dropsy, cirrhosis of the liver, and other vital indications of decay. These habits are acquired in early life. The wind is sown then and the whirlwind is reaped later on. It is seldom that the young will learn the importance of, if I may so express it, training for old age, but there are exceptions to this rule. Only a few days ago a man came to consult me; he belonged to the luxurious classes, and, though only twenty-three years of age, seemed to have the forethought of a man of sixty. A fine, handsome young fellow of nearly six feet, he said to me: "Doctor, as most of my family have died young through becoming excessively fat, I want to know what I am to do to avoid this. I am already heavier than I should be." Now, a man in the full enjoyment of health and bodily vigor, who had so much foresight, and who wished to learn the means of attaining green old age, which he saw would be sapped by a hereditary tendency to obesity, undoubtedly deserves to do so, especially as the particular condition that he dreads can be so easily benefited without debarring him almost every luxury within his reach.

If more people followed this example, how many years longer

would the average life be, and how much more pleasant would life become! One of the greatest barriers to the enjoyment of life in old age is the condition that this young man dreaded; and my experience is that the food of old people is by no means always what it is wise for them to take. It seems to be the general opinion that old people should be always eating, that they should be stuffed, and that farinaceous food is what they should principally take. This, every one knows, tends to develop corpulency, which is, as I have explained, a most undesirable condition.

I find that if old people are put on a good meat diet in the way of strong soup, beef tea, and animal food, and only just sufficient farinaceous food and fats and sugar to maintain the heat of the body, they increase wonderfully in energy and, as they often express it, feel twenty years younger. This is only natural; it is a food of energy; the food that builds up muscle, nerve, and constitutional stamina.

The requirements of the system in old age, as a rule, are not very great, and more harm is done by taking too much food than by taking too little. I have known people considerably over seventy derive the greatest benefit from a thorough change in diet. It seems to rejuvenate them. Of course, in old age care should be taken that the body is not subjected to rapid changes of temperature. When the nervous power is decreasing as the result of age, and the system is losing the power of combating cold and strain upon its energy, a stimulating diet invigorates, and is conducive to maintaining constitutional stamina better than any other.

Any natural death but from old age and general decay is an accidental death; that is, it is due to causes which might, and even perhaps could, have been entirely avoided and remedied in earlier years. But, of course, all the secrets of attaining extreme age are not even now within our reach, and the few that I have pointed out are but a very few, and those of the commonest. It is the inevitable law of Nature that we must die. The vital energy that is implanted in the body at birth is only meant to sustain it for a certain number of years. It may be husbanded or wasted, made to burn slowly or rapidly. It is like the oil in a lamp, and may be burned out to little effect in a little time, or carefully husbanded and preserved, and thus made to last longer and burn brighter. It is a moot question whether every individual is not at birth gifted with the same amount of vital energy and of life-sustaining power. The probability is that each is. The circumstances of the environment from the cradle to the grave determine its future destiny.

It is a well-known fact that half of the infants born in certain

crowded streets in Liverpool die before they arrive at the age of one year, whereas, under ordinary or healthy surroundings, a half would not die within the first five years of life. Why is this so? Simply because the surroundings are so detrimental to healthy development. Again, consumption is fatal to sixty thousand people in England alone, annually, and this is a disease born of hereditary taint, due to unhealthy surroundings and other health-depressing influences. In fact, as I have before said, most of the diseases which destroy in early life are due to causes which ought not to exist, and in time, as sanitary science advances, will not exist. We know that already the improved sanitation of the country is bearing fruit, that the average life is lengthening year by year, that many diseases that carried off tens of thousands in the days of our grandfathers are almost harmless now.

Smallpox has lost its terrors. The causes of such fatal diseases as typhoid, diphtheria, etc., are well established, and doubtless, in time, these plagues will be rooted out.

Last year we escaped an epidemic that might have carried off hundreds of thousands, and why? Because we know its ways, and have not allowed it to spread in the country. The highest duty of the state is to guard the health of the people, and public opinion of recent years is waking up to this fact. An epidemic is no respecter of persons; it may have its origin in the hovel of a pauper, but its baneful influence reaches the lordly palace of the noble, and it ingulfs all classes in its deadly embrace. The aristocrat and the plebeian are socially separated by a very wide gulf, but as far as epidemic disease goes they are conterminous. Social distinctions are no barrier when the angel of death is following in the wake of those plagues that destroy life before its natural termination in old age and general decay.

To sum up, if old age is to be put off to its furthest limits, the individual who wishes to attain it should live carefully up to middle age, taking plenty of exercise, and so adapting the diet that corpulency, gout, and other diseases due to taking too much and improper food without doing sufficient physical work to consume it, can not be developed. Mental and physical occupation are an absolute necessity, if the constitution is to be kept in healthy working order, and this applies equally to both sexes. The human economy will rust out before it will wear out, and there are more killed by idleness than by hard work. Human energy must have some outlet, and if that outlet is not work of some kind, habits are acquired that are not always conducive to long life.

Old age is the proper termination of human life, and, as Cicero says: "The happiest ending is when, with intellect unimpaired, and the other senses uninjured, the same Nature which put to-

gether the several parts of the machine takes her own work to pieces. As the person who has built a ship or a house likewise takes it down with the greatest ease, so the same Nature which glued together the human machine takes it asunder most skillfully."

Death by extreme old age may be considered the desirable end of a long-continued and at times weary journey. The pilgrim begins it in infancy, full of hope and life; continues it through adolescence in its roseate hue; and onward until middle age, with its cares and anxieties, begins to dispel the illusion. Then comes the time of life when vitality begins to decline, and the body to lose its capacity for enjoyment; then comes the desire for rest, the feeling that foreshadows the great change; and if this occurs in extreme age, the sufferer seems to fall asleep, as he might do after severe fatigue.

So the long and, in many cases, the weary pilgrimage of life is brought to a close with little apparent derangement of mental powers; the final scene may be short and painless, and the phenomena of dying almost imperceptible. The senses fail as if sleep were about to intervene, the perception becomes gradually more and more obtuse, and by degrees the aged man seems to pass into his final slumber.

In such an end the stock of nerve-power is exhausted—the marvelous and unseen essence, that hidden mystery, that man with all his powers of reasoning, that physiology with all the aid that science has lent it, and the genius of six thousand years, has failed to fathom. In that hour is solved that secret, the mystery of which is only revealed when the Book of Life is closed forever. Then, we may hope, when Nature draws the veil over the eye that is glazing on this world, at that same moment she is opening to some unseen but spiritual eye a vista, the confines of which are only wrapped by the everlasting and immeasurable bounds of eternity.—*The Gentleman's Magazine.*

G. A. Leboret, writing of the late disaster at St. Gervais, Switzerland, from the breaking of a glacial dam, and recalling other stupendous calamities of like character, charges British geologists, living in a country where Nature's moods are mild, with being too averse to admitting cataclysmal phenomena and of being disposed unconsciously to belittle and almost ignore the occasional violent action of the various rock-destroyers. With such catastrophes in mind as have occurred several times in the Alps, of which that of St. Gervais is only one specimen; with the flood in the Indus in 1835, beside which these sink into insignificance—and not forgetting our Johnstown flood—one must hesitate before assigning too uniform a degree of intensity to the various agents of denudation; nor can one easily avoid the conclusion that, as regards some of them, their rate of work was occasionally far greater in past than in present times.

CHILDREN'S QUESTIONS.

MY little daughter is sitting very quietly on the floor beside me, busily engaged in arranging her colored house blocks in streets and lanes. She seems so completely absorbed in her play that I am careful not to speak to her, or even to look at her, lest I should disturb her. Suddenly, however, she drops her little houses and, looking earnestly at me with her blue eyes, she asks:

"Mother, does everybody die?"

"Yes, dear; everybody," I answer, struck by her question.

"The very good ones too?" she questions on timidly.

"Yes, the good ones too. God takes them to him because he loves them, and wants them to be with him in his beautiful heaven."

For a while the little one remains quiet; then again, coming up and nestling at my side, she says:

"Mother, wouldn't it be all the same to the loving God if he didn't take me into heaven, but left me always here with you?"

Drawing her closer to me, I try by caresses and loving words to calm all the doubts of her little heart. She is in an inquiring mood, however, and shortly begins anew:

"Mother, does the angel who brings the little babies carry them in a box or just in his hand?"

Unprepared for this question, I answer hesitatingly, "No, not in a box."

"But they have dresses on, haven't they?"

"No, darling, the little babies come naked into this world."

"But then, mother, how can the parents tell whether it is a girl or a boy?"

Once more I am at a loss, but make out to say, "Oh, we see that in their faces."

The little one is satisfied for the moment, for she turns again to her toys. Suddenly an idea strikes her. "Mother, father said the other day that I had the face of a boy. Perhaps I am not a girl at all." This time I can answer without hesitation: "No, dear, you are certainly mother's own dear little girl. But now don't ask any more questions, but come and help me to bake in the kitchen."

The child is quite content to do as I say, and, following me, devotes her mind with as much seriousness to the cooking, or rather to watching it, as she had before shown in trying to arrive at the origin of mankind. Truly, there is something wonderful in the growing mind of a child. The world and life are full of insoluble problems for the adult understanding, but to the mind of a child every new phase of things comes as a riddle and a mystery. What

wonder, therefore, if in their struggle for knowledge, and the efforts they make to learn from the experience of their elders, their whole being becomes, as it were, one big, interminable question!

At times, of course, it can not be denied, the questions become irksome, but who would wish a child to ask no questions? Julius Sturm tells, in one of his pretty fairy tales, how a grandfather, driven into impatience by the constant questionings of his grandchild, exclaimed, "I wish your tongue were out of joint!" but when, unexpectedly, his wish was fulfilled, and the child became dumb, how he joyfully exchanged one of the two years which an angel had prophesied he was yet to live for the privilege of hearing the little one's prattle again.

A child whose questions are not answered by its parents will either turn to others who are willing to gratify its desire for knowledge, but who perhaps are unable to distinguish between what is good for a child to know and what is not, or else it will lose its fine natural susceptibility, and learn to look upon life in a dull, spiritless way, without interest or curiosity. Worse, however, than not answering a child's questions is to ridicule them. Nothing wounds a child so deeply as finding its inexperience abused and its earnestly-meant questions made the subject of mockery. How common a thing it is to hear a child's question impatiently and even contemptuously condemned as "silly"! Yet, in most cases of the kind, the silliness is not with the child, but with the older person who fails to understand how a child's mind works. Every child has involuntarily a feeling of distrust for grown-up people, which is only expelled through trust in the love of its parents. This trust once thoughtlessly abused and shaken may perhaps never be restored to its original purity and strength; and who could have the heart deliberately to impair such sweet confidence?

It is true children sometimes ask questions which it is not easy to answer, at least not in the short, simple form suited to the mind of the questioner. For example:

"Do the little sparrows know they are sparrows?"

"Do animals go to heaven, too?"

"Can God do everything?"

"Can he make my birthday come twice in one year?"

Or, again:

"Why does the fire burn?"

"Why is ice cold?"

To answer such questions may baffle our knowledge, but we should at least make an honest and patient effort to say something helpful. If we can not give all the light we could wish, we can at least give sympathy and encouragement.—*Translated for The Popular Science Monthly from the German, by F. M. J.*

EAST CENTRAL AFRICAN CUSTOMS.

By JAMES MACDONALD.

PART II.

AN institution peculiar to Central Africa is the prophetess,* who combines with her prophetic functions the office of witch detective. As she is the most terrible character met with in village life, a detailed account of her office and method of procedure may be interesting. It is to the prophetess the gods or ancestral spirits make known their will. This they do by direct appearance, and in dreams or visions. The prophetess, who is frequently the chief's free wife, dreams her dreams and then gives forth oracles at intervals, according to the exigencies of the case. These are generally delivered in a kind of hysterical frenzy. When she sees the gods face to face, which always happens at the dead hour of night, she begins by raving and screaming. This she continues till the whole village is astir, and she herself utterly prostrated by her exertions. She then throws herself on the ground, and remains in a state of catalepsy for some time, while the villagers gather round her, awe-stricken, waiting for her revelations. At last she speaks, and her words are accepted without question as the oracles of God. Has she not seen the ancestors face to face? Has she not heard their voice sending a message to their children? Is she not their friend, to whom they have shown favor? Must not all hear the words of those who have gone before?

After these revelations, the prophetess may impose impossible tasks on men, and they will be attempted without question. She may order human sacrifices, and no one will deny her victims. Suppose she, for any reason, declares that a person must be offered in sacrifice to a mountain deity—for there are gods of the valleys and gods of the hills, deities of the rivers and of the forests—the victim is conducted to a spot indicated by her, and bound hand and foot to a tree. If during the first night he is killed by beasts of prey, the gods have accepted the sacrifice, and feast "on his fat," which is "as the smell of spices in their nostrils." Should the victim not be devoured, he is left to die of starvation, or is thrown into lake or river with a sinker attached. "The slave was not worthy of the god's acceptance. He is worth nothing to any one." Fowls and other animals killed in sacrifice are not burned; they are simply left near the "prayer tree," and when devoured during the night the sacrifice is accepted. Among the tribes

* Wololo tribe and Lake Shirwa district generally.

farther south, animals sacrificed are cooked and eaten, with the exception of the sacred portions, which are burned with fire.

As a detective of wizards and witches, the prophetess is in constant demand. When traveling on official duty in this capacity, she goes accompanied by a strong guard, and when she orders a meeting of a clan or tribe, attendance is compulsory on pain of confessed guilt. When all are assembled, our friend, who is clad with a scanty loin-cloth of leopard skin, and literally covered from head to foot with rattles and fantasies, rushes about among the crowd. She shouts and rants and raves in the most frantic manner, after which, assuming a calm, judicial aspect, she goes from one to another, touching each person's hand. As she touches the hand of the bewitcher she starts back with a loud shriek, and yells: "This is he, the murderer; blood is in his hand!" I am not certain if the accused has a right to demand the *mwai*, but it appears this may be allowed. My impression is that the law does not require it, and that the prophetess's verdict is absolute and final. The condemned man is put to death, witchcraft being a capital crime in all parts of Africa. But the accuser is not content with simply discovering the culprit. She proves his guilt. This she does by "smelling out"—finding—the "horns" he used in the prosecution of the unlawful art. These are generally the horns of a small species of antelope, and which are *par excellence* "witch's horns." The prophetess "smells out" the horns by going along the bank of a stream, carrying a water vessel and an ordinary hoe. At intervals she lifts water from the stream, which she pours upon the ground, and then stoops to listen. She hears subterranean voices directing her to the wizard's hiding place, at which, when she arrives, she begins to dig with her hoe, muttering incantations the while, and there she finds the horns deposited near the stream to poison the water drunk by the person to be bewitched. As they are dug from the ground, should any one, not a magician, touch them, even accidentally, the result would be instant death.

Now, how does the detective find the horns? By what devil's art does she hit upon the spot where they are concealed? The explanation is very simple. Wherever she is employed she must spend a night in the village before commencing operations. She does not retire to rest like the other villagers, but wanders about the live-long night, listening to spirit voices. If she sees a poor wight outside his house after the usual hour for retiring, she brings that up against him next day as evidence of guilty intention, and that, either on his own account, or on account of his friend the wizard, he meant to steal away to dig up the horns. The dread of such dire consequences keeps the villagers within doors, leaving the sorceress the whole night to arrange for the tableau of the following day.

In addition to the horns, arms and pieces of human flesh may be dug up in suspicious places, and this is the carrion on which witches and wizards feed. Any one tasting a morsel of such food is himself thereby converted into a wizard. Witches and wizards have midnight feasts, so says the legend, at which they gorge themselves with human carrion. Hence it is that in many parts the dead are not buried till putrefaction sets in, and graves are watched a considerable period after interment. The detective may not be known as such to a wizard, and may pretend to follow the same art in order to gain his confidence. If, then, the wizard offers the detective human carrion, no further proof of guilt is needed. Whether such food is ever offered to these rogues it is difficult to say, as their word is accepted without question or inquiry.

Witches can cause milk to flow down through a straw from the roof of a house,* and by this means rob their neighbors of the milk of their goats and cows. When I read of this superstition for the first time it reminded me of an incident, connected with a similar Celtic superstition, which happened in Sutherlandshire about twelve years ago. In that region a superstition still lingers that witches can "steal the feet" of cows by walking through the fields while the dew is on the grass, dragging a rope made of cow-hair after them. A Thurso mason, well acquainted with north country superstitions, was employed in the district at the time referred to, and got a quantity of new milk daily from a crofter's wife. At the beginning of August she sent to say she could no longer let him have new milk, as that went to the shooting lodge, but he could have milk from which the cream had been taken. The wily rogue sent her the following message: "Tell your mother I do not wish to be nasty, but I must have new milk, if not by fair means, then otherwise. I shall take it from the rafters of the house rather than want." Next morning the girl appeared with skimmed milk, thin and blue. Malcolm had meantime made his preparations. He had bored one of the roof couples, and fixed a bladder filled with milk in the thatch so as to empty its contents through the hole when required. He then carefully plugged the hole. When he saw the quality of the milk sent, he asked the girl into the house that she might see what happened there. He next took an auger and bored the plug away, when down came a stream of rich milk and cream. After that he had but to ask what he required. No one dared refuse his most extravagant demands. His reputation as a wizard spread far and near over the country side, and still lingers there among the superstitious.

Wizards visit their victims while asleep, and "instill" a power-

* This is pretty general in East Central and South Africa.

ful poison, known only to themselves, into the ear.* For this there is no cure; the patient withers away, and dies "when all the flesh has melted off the bones." They bewitch fowls, cattle, crops, everything a man possesses. They make his wives barren, and himself incapable of begetting children. They put enmity between him and his friends. In one word, there is no evil but they practice, and a great deal of the legislation of the country is designed to put down this crime, and punish those who are found guilty of it.

In South Africa war resolves itself into a cattle hunt; in the lake region of East Central Africa it is largely a slave hunt. A dangerous neighbor or rival can be effectually curbed by carrying away a large number of his subjects and sending them to market. This resolves war largely into raiding by means of a sudden and unexpected descent. The elaborate preparation of the South would warn the whole country, and while the doctor was engaged "charming" the army, and distributing magic tokens to render the braves invulnerable, the enemy would have put "seven hills" between himself and the advance column. All the same, there is a close resemblance between the war usages of the South and what we find in Central Africa. There we find, especially among the Angoni, the Basuto habit of cutting out an enemy's heart and liver, and eating them on the spot. We also find the habit of mutilation, for the purpose of reducing the parts to ashes, to be stirred into a broth or gruel, which must be "lapped" up with the hand and thrown into the mouth, but not eaten as ordinary food is taken, to give the soldiers courage, perseverance, fortitude, strategy, patience, and wisdom. Should a brave leader retire to a mountain, and die there unconquered, his spirit becomes, according to Yao tradition, the guardian of the rain clouds that gather there, and to him offerings and prayers are presented at the great national gatherings for rain. Mantanga inhabits Mangohi, the mountain the Yao remember as their home, and to him they pray and sacrifice for rain. He is liberal to his children, and bestows great plenty. Chitowe, on the other hand, is surly, and is associated with drought, famine, and leanness. He sometimes appears as an emaciated child or a young woman. These, and many others, are the spirits of warriors who perished centuries before the white man came to bring a new and terrible implement of destruction, and to introduce strange customs and stranger gods to people whose ways have been uniform since before the Flood.

Death is largely caused by wizards. The very introduction of death into the world has a suspicious look of witchcraft about it; in any case, it was caused by a woman who taught two men to go

* Manganga, Angoni, Yao, Walolo.

to sleep. One day while they slumbered, she, more cruel than Jael, held the nostrils of one till his breath ceased and he died.* So it happens that "death and sleep are one word." When a man dies, if his death was caused by witchcraft, there is no safety for any one till the suspected person drinks the poison bowl. How such are discovered has been already indicated; the poor wretch who must drink the poison may be the man's most intimate friend, his nearest relative, or perhaps his wife. There are even occasions when a large quantity of *mwai* is prepared and numbers take it together. In this case wizards and witches are "cleaned out" wholesale. The practice is not uncommon on the Shire and the Zambesi.

Apart from the discovery of the culprit, the dead are mourned for by a persistent beating of drums by night and by day,† and also by a continued howling kept up by relatives and others, of whom many may be hired for the occasion. The louder the drumming, the greater the grief. Relatives shave their heads, and in the case of a chief this is done by all his tribesmen. At the grave offerings are made, and the same is continued for a varying period at the votive pot placed on the site of the deceased's house.

At times, in the case of persons of social importance, as generals in the army and councilors, mourning is prolonged for many days before sepulture takes place, and in that case the body is incased in bark and placed in a suitable position, with a hole dug in the floor underneath to receive the decomposed and putrefied matter which exudes from it. The body is ultimately buried in the house, which is razed, and the materials carried away, that the spot may be leveled and a votive pot placed there. A slave is frequently killed and put in the same grave with his deceased master, that the latter may not have "to go alone." Enemies killed in war are not buried.

When sepulture is to occur in the usual place, and according to the general custom of the country, the body is wrapped in a mat, usually the person's bed, and a curious custom observed by Yao and Wayisa, who perform this office, is washing their hands as a ceremonial act. This is quite distinct from the idea of uncleanness after handling a dead body, which requires bathing in running water before eating or associating with their fellowmen. After the ceremonial act of washing is performed, the body is carried to the grave suspended along its length to a bamboo pole. When the grave is dug, it is carefully lined with palisades and green branches. At either end a forked stick is driven se-

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* Yao tradition, told also by Wayisa.

† Macdonald, Description of Funeral and Mourning Customs in Nyassa Regions. Mock funerals are most common among the Angoni.

curely into the ground at the bottom of the grave, and the body suspended to the bamboo pole is placed in position, the ends of the bamboo resting on the forked sticks, and preventing its touching the ground. A canopy of boughs is then placed over it to prevent the earth falling down on the body, and the grave is filled in as is usual. A slave may be killed to accompany the deceased, but not necessarily. The house occupied by him is burned, and a votive pot placed on its site. Similar pots are also placed on the grave. When the chief of a tribe dies, he is buried in his house, which is not taken down nor burned, and in this case the votive pot is placed outside the door, under the veranda. The personal articles of the deceased—pipes, broken spear, walking-sticks, ornaments, badges of office, charms, and wallet—are placed in the grave, and this seems to be common among all, or almost all, African tribes. When mourning for the dead is concluded, which is after a varying period, there are feasting, drinking, revelry, and a second shaving, after which the dead is forgotten, or at all events seldom or never mentioned except as an ancestor to be worshiped, and then not by name, but by relation—"my father," "my brother," "my chief," "my chief's son," etc.

A man worships the spirits of his own ancestors; a village, those of its departed heads; a tribe, those of its chiefs. The names of great warriors are kept long in remembrance, and we meet with many such whose history, exploits, and country are quite lost, but whose memory tradition preserves as great spirits who are high in rank above ordinary ancestral gods, and on whose will depends the destiny of peoples and the conditions of life as regards plenty or scarcity. This is common to almost all Bantu tribes. Worship takes the form of prayer, offering, and sacrifice. Reference has been made to the manner of human sacrifice, and its frequency among certain tribes is appalling. When the gods are offended, men must die; when hungry, cattle or fowls serve their turn; and when only to be propitiated, as in view of a favor desired, flour or corn is acceptable to them. At great national gatherings—as for rain—the magician, in the priestly character, conducts the sacrifice and the prayers, as also in cases of disaster and national mourning. In connection with rain-making, the chief supplicates his own special god or guardian ancestor. A dance is held in his honor, and the chief throws up water to indicate that he prostrates himself and his people at the spirit's feet, who has the giving or withholding of that for which they pant and die. At times *Mpambe* (lightning), in the form of a deity of the clouds, is invoked for rain by Yao and Shirwa tribes, but *Mulunga*, the great spirit—or more properly great ancestor—is the deity to whom men look for help in times of distress and drought. This worship of Mulunga leads to a kind of tribal pantheism in

the lake region, for, after all, is not the Earth the mother of us all, Mulunga himself included? In the more private devotions of the people of the Nyassa region Mulunga does not appear, but a man may not only pray and sacrifice to his own ancestors, but also to the old inhabitants who occupied the country before his forefathers took possession of it. The people are gone, all dead, but their spirits live, and dwell in the old place, and see all that goes on in which they take an interest. There do not seem to be family and tribal distinctions as such among spirits; in any case, they do not fight about territory as men do. No Milton has yet appeared in Central Africa to set the spirits by the ears.

The dead, however, may reappear in the form of animals, but only for pure mischief.* Widows are often held in bondage and terror by their lords returning in the guise of a serpent. This brute will enter the house, hide in the thatch, and look at its victim from between the rafters. It will coil itself by the fire and steal into the beds; it will glide over articles of food and explore the interior of cooking utensils. For this persistent persecution there is but one remedy, and that is to kill the serpent, when there is nothing left but "pure spirit," which can not appear in material form any more.

A Yao spirit appearing in material form is different from a spirit's messenger, which also appears in animal guise. The latter may be a bird, a form which a spirit can not assume, but which can be sent as a messenger, to make known the spirit's will, somewhat after the manner of those sacred chickens which the stout old Roman threw over the side when they refused to eat. The African, too, can deal somewhat summarily with bird messages when his interests and inclination lie in that way, but this implies a degree of courage which is phenomenal.

Among the Angoni and the people dwelling on the western side of Lake Nyassa there is a common belief that demons hover about the dying and dead before burial, to snatch away their souls to join their own evil order. By the beating of drums and firing of guns such evil spirits are driven away, but a more certain method of avoiding their machinations is to have a mock funeral, and so mislead and confound them. When it is determined to have such a funeral, an artificial body is manufactured of any convenient substance, and treated exactly as is done with the bodies of the dead. This lay figure is carried a considerable distance to a grave, followed by a great crowd, weeping and wailing as if their hearts would break. Drums are beaten, guns fired, and every species of noise made. Meantime the real corpse is interred near the dwelling as quietly and stealthily as possible. The evil

* Angoni, Manganga, Waomba, Anyasa, etc.

spirits are effectually deceived; when the mourners retire, there is nothing in the mock grave but a bundle of rushes, while the true grave they do not know and can not find. Traces of this still linger in the South.

As the African must account for the origin of death, so, too, he has a theory regarding the first appearance of man on the earth. Both he and all other animals came out of a hole in the ground, after which Mulunga—the great ancestor—closed up the opening. The place is now desert, no man dwells there, and the spot is known to none. The gods refuse to reveal it. Whether this is that it may not be opened, and other creatures be allowed to escape from it, their philosophy does not very clearly explain, but what is very certain is, that monkeys were men at the time of their exit from the earth,* but having quarreled with their friends, went to "dwell in the bush." To vex and harass those whom they left, they began to pick the seed from the ground after it was sown, and this habit having grown to be hereditary, monkeys can not grow corn, as they "could not leave their own seed in the ground," which is perhaps as good a definition of the difference between men and monkeys as any given by scientists.

Reference to monkeys reminds one of that wonderful procession seen by the pasha, where each carried a torch to light him in his depredations among the corn-fields—a story which one man explains by referring it to Emin's defective eyesight, another to a possibility of monkeys being able to produce fire by friction. Without giving any opinion regarding the accuracy of the observer, a statement made to me by a South African native, a Pondonusi, may throw as much light upon it as all our science. At the time I paid little attention to it, and indeed it passed quite from my mind till I came across the pasha's story in Mr. Stanley's book. It was, so far as I can recollect, in the following words—the connection in which it was told is of no importance: "The master is surprised. There are monkeys in the mountains" (the gorges of the Drakensberg) "that go to the fires men leave in the bush, and carry away burning sticks; they even go up the trees with them, and then throw them down. I have not seen it myself, but I have heard say that when women leave a fire near the edge of the bush, they come out to the grass openly with burning pieces of wood, and play with them—some say they carry them back to the fire to make them burn better." If this is a true and sober version of what is not uncommon, a little less science and a little more ordinary intercourse might have saved the eminent if erratic German a good deal of idle speculation. One can quite fancy monkeys playing with fire-brands found near the edge of

* This tradition Mr. Macdonald found common in the Shirwa and Nyassa regions.

the forest, carrying them off in their march to the corn-fields, to cast them aside when the work of depredation began.

If man's origin can be satisfactorily accounted for, his destiny is shrouded in impenetrable gloom. All spirits live, nor can they be killed; but how employed or what country they inhabit is known to no one. It is true a man's ancestors watch over his life, and the chief's ancestors guard the honor of the tribe, but beyond this all is uncertainty and doubt.* A man's spirit is not at his grave, though it may be met there; it is not at his old home, but still it sees the offerings placed in the votive pot. It does not inhabit his son's house, though he can not cut his nails or trim his hair without his father's eye being upon him; and should he fail to bury the clippings of his nails or to burn the produce of the barber's shears, he may expect to be reminded of it in the most unpleasant manner. Nor is it a man's own actions alone that come under the cognizance and censorship of his father's ghost. Should his wife, while he is on a journey, anoint herself with the oil or fat in daily use, she will not only suffer herself, but bring calamity upon her husband; should she dream during his absence, she must offer a private gift for herself and the absent one. So far the wishes of spirits are known, but how they employ themselves in the spirit land, and what are the mutual relations between them, has never been told. A chief remains such in virtue of his office, but as to the relations between rival chiefs and old enemies, "the people who are here do not know; it never was known, for they never told."

Turning from speculations regarding creation, life, and death to the daily concerns of this world, we meet with a number of very curious minor customs and institutions among the Yao and allied tribes. One of these is that of surety, or what we might call God-parent. Every girl has a surety, and when her hand is sought in marriage it is this official who is approached, and not her parents. He makes the necessary arrangements, and sees what provision is to be made for her and her children, should she have any; and also, in the event of her being sent away without just cause, how she is to be supported and cared for. When a free wife—for this institution applies only to free women—is dismissed, she returns to her surety, and he redresses her wrongs, and makes such adjustments as the circumstances admit of.

In the ordinary conduct of affairs, domestic and public, women have no voice; everything is regulated by the men, who may be said to sit perpetually in council. A Yao woman, asked if the

* The following customs are gleaned from notes and references by missionaries in the Nyassa and Tanganyika Lake regions, no particular tribes being named. The customs seem common.

child she is carrying is a boy or girl, frequently replies, "My child is of the sex that does not speak." The position of woman is practically that of a chattel. Women kneel when addressing men, and go off the public path into the grass or bush when they meet any of the opposite sex as a sign of subordination and subjection. Young girls do not take milk; if they did it would make them barren. Women, especially Makololo, wear a lip-ring the size of a small table napkin-ring in the lip, not suspended, as earrings are, but inserted into the lip as the "eyes" through which "reef points" pass are inserted between the canvas of the sail and its "bolt-rope." It causes the lip to project an inch and a half in front of its natural position, and at right angles to the teeth and gums. A small brass or lead ornament is suspended from the side of the nose, which is pierced for the purpose as the lobe of the ear is for earrings. Some of the front teeth are knocked out as a beauty mark, and the arms, cheeks, breast, and shoulders are tattooed with strange and fantastic devices. Necklets of teeth, shells, or bits of wood are common, and brass wire is in great demand for bracelets and anklets. The dress consists of a loin-cloth of skin, cotton, or bark. The latter is made by stripping a piece of bark from a tree, and then beating it with an ebony hammer till soft and pliant. It is easily torn, and even when treated with the greatest care does not last long. On the Shire and round Lake Nyassa the people have hardly any stock except fowls and a few goats, and are thus precluded from having the comfortable sheepskin garments so common among the Kaffirs. Domestic animals are precious in Central Africa, so when chickens are hatched the abandoned egg-shells are collected and hung up in the house to protect the brood from hawks and accidents of all kinds.

The principal industries among the tribes whose customs I am considering consist of pottery and working in iron.* They manufacture clay pots of beautiful design, and burn them with considerable skill. There is a tradition lingering in odd corners that once upon a time their ancestors used hollow stones as pots before the art of pottery was discovered. If this is true—of which there is no adequate proof, however—it effectually disposes of Don Santos's idea that the East Central African had gradually degenerated from a higher civilization, and points rather to a record of progress. And there seems to be beyond question steady, if slow, progress in their skill in working metal and fashioning implements of war and husbandry. There is no question that within a comparatively recent period they tilled the ground with wooden

* The Angoni own a tribe of inner Africa which they have reduced to the position of domestic slaves. They are the best smiths in the lake region. Whence they came I do not know, but they were not natives of that region originally.

implements, for the memory of it lives in universal tradition among them. At no very remote date a Tubal-Cain appeared, and since his day the iron-headed hoe has found its way into the remotest hamlet, and the national ingenuity has found exercise in fashioning and ornamenting weapons of war. The improvements made in the manufacture of implements of husbandry and tools for the craftsman are insignificant compared with the advance in the manufacture of spear and battle-axe. The iron they smelt from its native ore by a primitive process of blast furnace, and then work and temper it much as was done by our country smiths two or three hundred years ago. I have seen spears of African manufacture, made by Baralong smiths, tempered so finely that it required a good Sheffield blade to turn their edge. This is, however, exceptional, and the vast majority of articles made are soft, and the iron coarse in texture when broken. In woodwork their progress has been slower, and beyond polishing spear-handles and the manufacture of musical instruments, pillows—a regular article of commerce—pipes, walking-sticks, and mallets, not much is done, the manufacture of canoes, their greatest triumph, being always excepted.—*Journal of the Anthropological Institute.*

[*Concluded.*]

THE BAY OF FUNDY TIDES AND MARSHES.

By FRANK H. EATON.

CONCERNING the Bay of Fundy the school-books generally note the single fact that "here the tides rise higher than anywhere else in the world." But so meager a reference to what is in itself an imposing exhibition of gravitational energy, helpful as it may be in a mnemonic way to the learner of geographical catalogues, gives no hint either of the extraordinary series of physiographical conditions which are the cause of this phenomenon or of those which it creates. The Bay of Fundy is remarkable not only for the grandeur of its tidal phenomena, but equally so for the exquisitely picturesque sculpturing of its coast line, and the diversity, range, and richness of geological evidence thereby revealed; for the unique character of the extensive alluvial tracts that skirt its head waters, and for the wealth of legend, tradition, and romantic incident embodied in the early history of the people that dwell about it.

What is the cause of the extraordinary height of the Bay of Fundy tides? What part have they played in the creation of the Acadian marshes? Whence have been derived the materials for this enormous alluvial deposit? And what is the source of its ex-

haustless fertility? These are questions often asked by tourists, and which are answered, imperfectly no doubt, in the following pages.

North of Cape Cod the continental coast line recedes abruptly westward, and then sweeps in a long curve northeastwardly till the head waters of the Bay of Fundy are reached. Turning again on itself, its course is westward to Cape Sable, from which it again stretches away toward the east as the southern shore of Nova Scotia. Thus, between Capes Cod and Sable lies the long, narrow, open Bay of Maine, which terminates toward the north and east in the landlocked Bay of Fundy. In the shallow waters of this larger open bay the tidal impulse, which over ocean depths moves only as a wave of vertical oscillation, is changed into one of translation. As the effect of this transformation the whole body of water moves first landward, and then, sweeping round with the curving coast line, skirts the southern shores of Maine and New Brunswick, till it reaches the narrow strait between Briar Island and Grand Manan. Compressed between these closer limits the water is forced onward with increasing velocity into the Bay of Fundy. Part finds its way into the Annapolis Basin and its tributary rivers, while the main current moves onward till it meets the tongue of land which terminates in Cape d'Or. Here it divides, the northern portion filling Shepody and Cumberland Basins; while the southern half rushes onward through the narrow entrance to the Basin of Minas. As it passes Cape Blomidon this swirling, eddying, foaming torrent reaches its greatest velocity—a rate of ten or twelve miles an hour.

Thus it is that the long, sickle-curved Maine coast gradually gathers up the water rolled upon it twice a day by the rhythmic ocean movements, and, throwing it backward, presses it at last into the funnel-shaped Bay of Fundy and its adjacent basins, covering with a semidaily flood the low and unprotected marsh-lined shores and filling the channels of the tributary rivers for many miles inland to a height of ten, twenty, or thirty feet above their fresh-water levels. Such, in a general way, is the set of conditions under which the spectacular and physiographical effects of ordinary tidal phenomena are exaggerated in the Fundy tides far beyond their normal limits. At some points the extreme elevation of the flood tide above low-water mark is as great as seventy feet. In some of the rivers, particularly in the Peticodiac of New Brunswick and in the Shubenacadie of Nova Scotia, the upward flow against the fresh-water current forms a rapidly moving wall or bore several feet in height, the rushing sound of which can be heard at a considerable distance, while in others the two currents meet and mingle so quietly that an observer can hardly tell where the backward flow begins.

Lining the shores of the head waters of the bay and spreading far inland up the valleys of its river tributaries are extensive tracts of alluvial marsh land of remarkable fertility, and differing in their origin from other so-called marshes. In general, alluvial deposits are formed in river basins, by materials washed down from higher levels by fresh-water floods; but here the whole deposit is of tidal origin, the result of a landward rather than a seaward transportation. Every incoming tide is freighted with a finely comminuted sediment, the product of the wearing action of the currents upon the sides and bottom of the bay. During the interval between the flood that covers the undiked river and basin margins and the ebb that leaves them bare again, the sediment is deposited as a film of soft and glistening mud upon the somewhat hardened material left by previous tides. Thus layer after layer accumulates, until the flat becomes too high for any but extraordinary tides to cover.

Instructive illustration these marsh flats often give of Nature's methods in the preservation of the records by which the geologist reads the physical history of the earth. So plastic and impressionable is the mud which an outgoing tide has left that it easily takes and holds the tracings of any disturbing contact. A wind-blown leaf, a resting insect, a drop of rain, may make in it a tiny mold which, hardened somewhat before the next incoming flood, receives thereafter successive linings to which it gives its form and markings. In this way even the rain-prints of a passing shower have been fixed, and then completely covered up; and yet when subsequently exposed, so perfectly were the spatter marks preserved, that one could tell in which direction the wind was blowing when the shower fell.

It is obvious that the deposition of tidal sediment can, in general, be made only between the lower and the higher limit levels of the ebb and flow. The accumulation of greater depths of mud than such a range permits can only be accounted for by the supposition of a gradual subsidence of the littoral areas—a movement which would also widen the area of tidal inundations. That such a steady and prolonged subsidence of the Fundy marsh-lined shores has been in progress since the marsh began to form is attested to not only by the surprising depths of mud accumulated, but also by the occurrence in many places, especially along the shores of the Cumberland Basin, of deeply buried forests which were clearly once above the coexistent tidal levels.

A general idea of the geological features of the great depression in which the Bay of Fundy lies is necessary to a fuller understanding of the nature of these Acadian marshes, and especially of the sources of their wonderful fertility. In early geological times, and until long after the close of the Carbonifer-

ous period, the bay was much wider and somewhat longer than it is now. The long ridge of trap rock, known as the North Mountain, which stretches as a huge wall between the Annapolis Valley along its southern, and the waters of the bay along its northern base, did not then exist, and the waters of the bay extended uninterruptedly over the whole of the Annapolis Valley to the base of the Silurian hills which, under the name of the South Mountain, now form the southern inclosure of the valley. Eastwardly the head waters of the ancient bay washed the Devonian and Carboniferous rocks of the Cobequid Hills, while the northern shore line of the present bay, skirting the southern limit of the Palæozoic rocks of New Brunswick, is substantially identical with that of the original bay.

In general character the tidal movements of this larger Atlantic inlet were the same as in the smaller modern bay. And the semidaily ebb and flow of the waters produced, by their incessant attrition with the carboniferous limestones, shales, and sandstones, and the other ancient rocks that formed the bed and margins of the bay, immense quantities of sand and mud—sediment that was redistributed over the greater part of the Fundy Valley. Subsequent changes of level caused a recession of the waters to within their present limits, and brought to view, as the Triassic, or new red sandstone, extensive areas of these deposits. These red sandstone strata are still to be seen in shreds and patches at various points in the Annapolis Valley and on the shores of the Minas and Annapolis Basins. Their general dip toward the north indicates that the epoch-closing movement which narrowed the Bay of Fundy within its present confines was a sinking of the bed along its northern or New Brunswick border.

Following this subsidence, and as the concluding events in the series of seismic convulsions by which the region gained its present topographical features, occurred the volcanic eruptions in which the North Mountain had its origin. This long, trappean wall forms the southern boundary of the bay from Cape Split to the extremity of Digby Neck, a distance of one hundred and twenty-five miles, the only interruption to its continuity being the singular gap called Digby Gut, which gives an entrance into the beautiful Annapolis Basin. Though there were probably many volcanic vents along this extended line of fracture, yet the scene of greatest activity was undoubtedly near Cape Split, at the entrance to Minas Basin, scattered along the shores of which on either side are isolated patches of amygdaloidal trap. Transverse ridges of the same volcanic rock run at intervals, also, across the bottom of the bay.

It is the grinding action of the Fundy waters upon these two Triassic rocks, the trap and its underlying sandstone, that provides

the tidal currents with an unfailing supply of muddy sediment. It is mainly in the erosion, transportation, and reprecipitation of these two rocks, and especially of the latter, that the process of marsh formation consists. The incessantly destructive tide-work may be seen at many points along the shore line, perhaps most conspicuously at the base of Blomidon. Here the sandstone foundation is continuously being cut away from under the superincumbent columnar trap; and at intervals, especially in the spring time, large masses of the igneous rock are loosened from the precipitous mountain side and crushed upon the beach below, where the solvent and abrading action of the waters can reach them. It is after one of these spring slides that the richest harvests of amethystine and zeolitic crystals, for the beauty and abundance of which the Minas shores are noted, can be secured. But it is along the bottom of the bay that the destructive tidal work is most extensive and effective. Here exist great troughs, furrowed out of the soft sandstone, many fathoms deep along the channel bed, with here and there the interruption of the transverse trappean dikes already spoken of.

The sandstone yields, of course, the greater part of the marsh-creating sediment. Its detritus consists of a large percentage of silica, a little clay, the iron which mainly determines its reddish color, and the calcareous matter which served as cement in the parent rock. This material, in the extremely comminuted form in which it occurs in marsh-land soil, would itself afford conditions highly favorable to the support of vegetable life. But an additional cause of the wonderful fertility of the Acadian marshes is the richness of the trap rock in various salts of potash, lime, and alumina which the action of the water mingles freely with the sandstone mud. The plant-supporting power of this complex soil is increased still further by contributions from the upland soils through the medium of the streams and rivers flowing toward the bay.

The great fertility of this alluvium may be inferred from the fact that portions of the Annapolis, Cornwallis, Grand Pré, and Cumberland marshes have been producing annually for nearly two centuries from two to four tons per acre of the finest hay. Besides, it is a common practice, after the hay has been removed, to convert the marshes into autumn pastures, on the luxuriant tender after-growth of which cattle fatten more rapidly than on any other kind of food. Thus, virtually, two crops are annually taken from the land, to which no fertilizing return is ever made. The only portions of the Acadian marshes that have as yet shown signs of exhaustion are those about the Chiegnecto branch of the bay, on the cliffs and bed of which the Triassic rocks do not occur, but in their stead a series of blue and gray "grind-

stone grits" of an earlier formation. In this region the marshes situated well up toward the head of the tide, where the red soil of the uplands has been mingled with the gray tidal mud, are good, while those lower down are of inferior quality and less enduring. Efforts are being made to renew and improve these inferior tracts by admitting the tide upon them.

In general, however, the necessity for periodic inundations by the muddy waters of the bay in order to maintain the productiveness of the marshes, as implied in the passage from Evangeline—

> "Dikes that the hand of the farmer had raised with labor incessant,
> Shut out the turbulent tides; but at stated seasons the flood-gates
> Opened and welcomed the sea to wander at will o'er the meadows"—

not only does not exist, but, on the contrary, some two or three years are required for the grass roots to recover from the injury done them by the salt water, when, as occasionally happens, an accident to the protecting dikes admits the *un*welcome flood.

The exceedingly fine texture of the soil, and its consequent compactness and retentiveness of moisture, render it for the most part quite unsuitable for the production of root crops, and at the same time adapt it admirably for the growth of hay and of cereals, especially oats, barley, and wheat. As a rule, however, the succession of grass crops is interrupted only at intervals of from five to ten or more years by a single crop of grain. The reproductive power of the grass roots declines perceptibly with long-continued cropping, so that a renewal of the stock by reseeding is occasionally necessary. For this purpose the marsh is plowed in the autumn or spring and new seed sown; but to avoid the loss of a season, since grass does not mature for harvesting the first year, grain is also sown and a large yield usually obtained. This plowing and reseeding at intervals often of many years is the only cultivation the soil receives or requires. There is no reason to suppose that abundant harvests of grain might not be obtained annually for an indefinite period, but, as this would involve annual tilling, the hay crop is more profitable.

Along the river estuaries the encroachment of the land upon the sea is in continual progress, so that there are always considerable areas of unreclaimed salt marsh, the lower portions of which are flooded every day, while the higher portions are covered only by the highest tides. The reclamation of such new marsh is effected by building around its seaward margin a wall or dike of mud to prevent all tidal overflow. After two or three years the salt will have sufficiently disappeared to permit the growth of a crop of wheat, and in a year or two more the best quality of English grass will grow.

At the head of Cumberland Basin an interesting experiment in

the reclamation of worthless land has been successfully tried. Large areas of swamp and in some instances shallow lakes have been connected with the tidal waters of the neighboring rivers by channels cut through intervening ridges of upland, thus effecting the double purpose of draining and of admitting the mud-laden tides. In this way, in five or ten years, many acres of worthless swamp have been converted into valuable dike-land.

The use of marsh mud as a fertilizer is very general among farmers to whom it is accessible. It is taken in the autumn or winter from the bank of some tidal creek or river, where the daily depositions can soon replace it, and spread directly on the upland. Its effects are twofold: it enriches with valuable supplies of plant food the soil to which it is applied, and it greatly improves the texture of all light and open soils, making them more compact and firm, and so more retentive of moisture and of those ingredients which are otherwise easily washed away. This permanent effect upon the physical character of the soil which the marsh mud produces renders undesirable its application to clayey soils already compact and firm and moist enough; for it makes them more difficult to work, and more impervious to atmospheric influences. To well-drained hay fields, however, which need but little cultivation, the mud may be advantageously applied, even though the soil be naturally stiff and heavy.

The French settlers were the first Acadian dike-builders. They brought the art from the Netherlands; and to this day no other class of provincial workmen is as skillful in the often difficult work of dike construction as the Acadian French. It was no doubt the existence of these vast areas of marsh land, whose potential value was even then clearly seen, that induced the first New World immigrants to settle about the Bay of Fundy shores; and it was these same broad, fertile marshes left unoccupied by the expulsion of the Acadian French that attracted the New England settlers, whose descendants now derive from them an income aggregating not less than a million dollars annually.

As described by B. F. S. Baden-Powell, in his In Savage Isles and Settled Lands, the aboriginals of Australia are an extraordinary people—to look at, "quite unlike any other human beings I ever saw. A thick, tangled mass of black hair covers their heads; their features are of the coarsest; very large, broad, and flattened noses; small, sharp, bead-like eyes and heavy eyebrows. They generally have a coarse, tangled bit of beard; skin very dark, and limbs extraordinarily attenuated like mere bones. But they always carry themselves very erect. . . . They wander about stark naked over the less settled districts, and live entirely on what they can pick up. . . . If not the lowest type of humanity, they would be hard to beat. They show but few signs of human instinct, and in their ways seem to be more like beasts."

SKETCH OF SIR ARCHIBALD GEIKIE.

THE most prominent features in Sir Archibald Geikie's geological work are his studies of the effects of volcanic force, beginning in Scotland and extending to many countries; and his explanations of the fundamental part which geological processes have played in shaping the topographical features of the land, and in the origin of natural scenery.

Prof. Geikie was born in Edinburgh in 1835; was educated at the high school and the university in that city; was appointed an assistant on the Geological Survey of Scotland in 1855; acquitted himself so well in that capacity that when the Scottish branch of the survey was made a separate establishment in 1867, Sir Roderick Murchison appointed him its director. In December, 1870, he was appointed to the new professorship in the University of Edinburgh of Geology and Mineralogy, founded by Sir Roderick Murchison, with a concurrent endowment by the crown. He held this position till the beginning of 1881, when he resigned it, to take the place of Sir Andrew C. Ramsay as Director-General of the Geological Survey of the United Kingdom, and Director of the Museum of Practical Geology in London.

The published record of Prof. Geikie's life relates exclusively to his investigations, papers, addresses, and books on subjects relating to geology. In this field he has labored with unceasing diligence, and to it he seems to have devoted the whole energy of his active career. Complicated problems presented themselves to him when he entered upon the surveys, of which he was called upon to work out the solutions. One of the first to attract his attention was the relation of the crystalline rocks of the Highlands to the Silurian strata on which they rest, which Murchison had accepted as normal; an assumption from which logically followed the hypothesis that these gneisses were altered sediments. Mr. Geikie gradually became dissatisfied with this view, and commissioned two assistants to review the fields in which the most decisive evidence was to be obtained, instructing them "to divest themselves of any prepossession in favor of published views, and to map existing facts in entire disregard of theory." From the evidence afforded by this survey, Murchison's view was proved to be a mistaken one; and for it was substituted the theory that the elevation of the mountains and the metamorphism of the gneisses were the effect of enormous pressure resulting in the folding and breaking of the whole border of the dry land. The mountains have been reduced to their present shape by denudation, by which also much of the evidence of plication has been washed away, while the remains of the disturbed rocks occupy the position

which suggested Murchison's view. The displacements were accompanied by modifications of the rocks, of which Geikie wrote that "in exchange for this (Murchison's) abandoned belief we are presented with startling new evidence of original metamorphism on a colossal scale, and are admitted some way into the secret of the processes whereby it has been produced."

Sir Archibald Geikie's chief geological work, according to the estimate of Nature, seems to be his exhaustive review of the volcanic history of the British Isles. The northwestern part of Great Britain is marked, like the Snake River region in our own country, by the evidences of the outpouring over the land of immense sheets of lava, which in the present instance took place in Tertiary times. Sir Archibald made it his task in the investigation of this phenomenon "to discern the site of the centers of eruption, and determine the old chimneys, the remnants of which give a glimpse into the lowest parts of ascending lavas; to discriminate the volcanic necks, the intrusive sheets and dikes, the bedded lavas and the tuffs." Evidences of still earlier volcanic activity were also found in the Old Red Sandstone of Scotland, and in the oldest formations of England and Wales. In order to prepare himself more thoroughly for the investigation of this phenomenon, Mr. Geikie traveled over much of Europe, from northern Norway to the Lipari Islands; then came over to Canada and the United States, and followed the course of our geological surveys, particularly in the Western States and Territories and the lava-covered regions. In another department of the same investigation he gave more attention to petrological studies than any Englishman had done before him. Besides giving rise to many valuable memoirs relating directly to what he had seen and observed, these studies contributed greatly to the enlargement of Prof. Geikie's views and to the increase of the breadth of his work; and some of their results may be seen in the greater richness of illustration apparent in his subsequent writings. Their mature fruit is presented as a whole in his presidential addresses of 1891 and 1892. He was especially interested, they being exactly in the line of his principal study, in the lava beds of Snake River; and in his essay on the Lava Fields of Northwestern Europe refers to them as the site which first enabled him to realize the conditions of volcanic action described by Richtofen—the emission of vast floods of lava without formation of cones and craters—and, without acquiescing in all that author's theoretical conclusions, to judge of the reality of the distinction "which he rightly drew" between massive eruptions and ordinary volcanoes with cones and craters.

We have referred to Prof. Geikie's work in tracing the origin of the present shaping of land surfaces and of natural scenery to its geological factors as constituting one of his special titles to

fame. To his aptitude in this application Nature largely ascribes the success of his more popular works, which, it says, "will be easily understood if we remember that in Sir Archibald's works the traditional barrenness of geology is always smoothed and adorned by a deep and intense feeling for Nature. Nobody has done more than he to associate geological science with the appreciation of scenery." Mr. G. K. Gilbert, in a review of his Text-Book of Geology, remarks as a single departure in the volume the elevation of physiographical geology to the rank of a major division. "The same title, it is true, has been placed by Dana at the head of a primary division of the subject, but it was used by him in a different sense. With Dana it is a synonym for physical geology; with Geikie it is 'that branch of geological inquiry which deals with the evolution of the existing contours of the dry land.' So far as the subject has had place in earlier treatises, it has been regarded as a subdivision of dynamical geology, and the classification which placed it there was certainly logical. In dynamical geology, as formulated by Geikie, the changes which have their origin beneath the surface of the earth (volcanic action, upheaval, and metamorphism) and the changes which belong exclusively to the surface (denudation and deposition) are separately treated. In physiographical geology the conjoint action of these factors of change is considered with reference to its topographical results. Starting from geological agencies as data, we may proceed in one direction to the development of geological history, or in another direction to the explanation of terrestrial scenery and topography, and if the development of the earth's history is the peculiar theme of geology, it follows that the explanation of topography, or physiographical geology, is of the nature of an incidental result—a sort of corollary to dynamical geology. The systematic rank assigned to it by Geikie is an explicit recognition of what has long been implicitly admitted—that geology is concerned quite as really with the explanation of the existing features of the earth as with its past history."

The subject was first formally presented from this point of view in the Lectures on the Scenery of Scotland viewed in Connection with its Physical Geology, which were delivered in 1865. At this time, as Mr. A. H. Green remarks in his review of a new edition of the lectures in 1887, the controversy respecting Hutton's theory of denudation as the main and most efficient agency in shaping the earth's surface was at its height. The author acknowledged in the preface to his second edition that his views when first published ran directly counter to the prevailing impressions on the subject; but now, after a lapse of twenty-two years, they were accepted as part of the general stock of geological knowledge. "How largely," Mr. Green says, "this result is

due to his own steady and powerful advocacy all geologists are aware; but he gracefully reminds us that we also owe much to the labors of those American geologists who have found in the Western Territories such convincing instances of the work of denudation in shaping the surface." The first part of the book, comprising the lectures, deals with land-sculpture in general, and describes the working of Nature's sculpturing tools. The reader is then taken in succession to the different characteristic regions in the country and shown in detail, with much wealth of illustration, how the hills and valleys and salient features have been wrought out. The subject could very well be treated in such a manner as to make the presentation of it formal and dry in the extreme; but, says Mr. Green, the author "knows and loves his fatherland too well to look upon it merely as the object of geological research. Legend and history, old ballads and modern poetry, have all been pressed into his service, and he interweaves into his narrative allusion and quotation in a way that enlivens even the most technical parts of the volume. The chapter on The Influence of the Physical Features of Scotland upon the People shows well what a vast amount of human interest attaches even to so special a science as geology."

Prof. Geikie himself predicted in an address before the Geological Society of Edinburgh, in 1873, for the future of his theory: "Of one thing I feel surely confident: When the din of strife has ceased and men come to weigh opinions in the dispassionate light of history, the profound influence of the Huttonian doctrines of the present time on the future course of geology will be abundantly recognized. By their guidance it will be possible to reconstruct the physical geography of the continents in successive ages back into some of the earliest periods of geological history."

Prof. Geikie's theory is further elaborated and applied in his five lectures, delivered at the Royal Institution, in 1884, on The Origin of the Scenery of the British Isles. In these lectures the author held that "the present surface of Britain is the result of long, complicated processes in which underground movements, though sometimes potent, have only operated occasionally, while superficial erosion has been continuous so long as any land has remained above the sea. The order of appearance of the existing features is not necessarily that of the chronological sequence of the rocks. The oldest formations have all been buried under later accumulations, and their re-emergence at the surface has only been brought about after enormous denudation." The lectures conclude with an indication of the connection between the scenery of a country and the history and temperament of its people. This subject was considered from four points of view, the influence of landscape and geological structure being traced in the

distribution of races, national history, industrial and commercial progress, and national temperament and character. Prof. Geikie found in the United States an emphatic confirmation of his theory in one of the most impressive features of our geology, which he records, in 1887, in a review of Newberry and Macomb's Survey of the Upper Colorado. "The whole of this Colorado basin or plateau is justly regarded as the most magnificent example on the face of the globe of how much the land may have its features altered by the action of running water."

The method based upon this theory prevails in Prof. Geikie's Physical Geology, which is described by Dr. Jukes as "an example of the treatment of geographical questions from the point of view of the geologist." The author is actuated, the reviewer continues, "by the conviction of the necessity for a broader and more vivid presentation of the action and reaction upon one another of the various forces acting and reacting upon the surface of the globe than is usually found in works on physical geography, in order to convey a just idea of the character and significance of the features which it presents."

The subject is again presented in the presidential address at the Edinburgh meeting of the British Association in 1892, the special topic of which was the commemoration of the centenary of Hutton's theory and uniformitarianism, and in which special stress is laid on Hutton and Playfair's recognition of the fact that existing inequalities in topographical detail "are only varying and local accidents in the progress of the one great process of the degradation of the land."

This breadth of view concerning the methods and purposes of geological study marks those of the author's addresses of which that was the principal subject. In the opening lecture before the class in geology of the University of Edinburgh, delivered in 1871, he advises his hearers, "Let us turn from the lessons of the lecture-room to the lessons of the crags and ravines, appealing constantly to Nature for the explanation and verification of what is taught."

The introduction to his Class Book of Geology, published in 1886, concludes with the words: "Geology is essentially a science of observation. The facts with which it deals should, as far as possible, be verified by our own personal examination. We should lose no opportunity of seeing with our own eyes the actual progress of the changes which it investigates, and the proofs which it adduces of similar changes in the far past. To do this will lead us to the banks of rivers and lakes, and to the shores of the sea. We can hardly take any country walk, indeed, in which, with duly observant eye, we may not detect either some geological operation in actual progress, or the evidence of one which has now

been completed. Having learned what to look for and how to interpret it when seen, we are as it were gifted with a new sense. Every landscape comes to possess a fresh interest and charm, for we carry about with us everywhere an added power of enjoyment, whether the scenery has been long familiar or presents itself for the first time. I would therefore seek at the outset to impress upon those who propose to read the following pages that one of the main objects with which this book is written is to foster a habit of observation and to serve as a guide to what they are themselves to look for, rather than merely to relate what has been seen and determined by others." At the very outset in this work, geology is regarded, "not as an amusement for the collector and a means of learning where he will get pretty and curious objects for his cabinet; not as a field where the ingenuity or perversity of the classifying mind may delight itself with grouping natural products as reason prompts; not in any other of those limited aspects beyond which it is feared the wisdom of some geologists never reaches; but as a history—the history of the earth in ages long gone by."

Believing that no branch of the study should be overlooked, we find him lamenting, in 1871, that while in all that relates to stratigraphic geology the British had kept ahead of other nations, they had allowed petrography, or the study of rock species, to fall into disuse. Matters had improved, partly perhaps under his own influence, in 1880, when, writing of the Mineralogical Society of Great Britain, he remarked upon a revival of interest in mineralogy, which had before been neglected for fossil-hunting.

In one of the reviews of Prof. Geikie's Science Primer of Geology, in 1874, a curious omission is remarked, in that the author had not referred to Darwin's theory of coral islands as a "proof that a part of the crust of the earth has sunk down" —the reviewer suggesting that to lead pupils up to this theory, and then test it as Darwin had tested it, was "an excellent exercise in that peculiar kind of reasoning about past causation which is of the essence of geology." Prof. Geikie appears to have built, as the saying is, better than he knew; for in 1884 he confessed himself reluctantly compelled, in view of Mr. Murray's observations in the Challenger Expedition, to admit that Mr. Darwin's theory could no longer be accepted as a complete solution of the problem of coral reefs.

Prof. Geikie has long taken an intense interest in the American geological surveys, and has followed them up with the closest attention for many years; and his notices of their reports and summaries of their results constitute a very considerable part of his frequent contributions to Nature. He was fully impressed with the magnitude and extent of the geological phe-

nomena of the United States, and of the value of the study of them for the contributions it affords to our general knowledge of the subject and the explanations it furnishes of phenomena in other countries.

Writing on the subject in 1875, he said the United States had certainly done noble work in the exploration and mapping of its vast empire. Having spoken commendatorily of the style in which the reports were prepared and distributed, he added, "But whatever be their external guise, these narratives are pervaded by an earnestness and enthusiasm, a consciousness of the magnitude of the scale on which the phenomena have been produced, and yet a sustained style of quiet description, which can not but strike the reader." In reviewing Hayden's Report at the end of 1883, he ascribes a singular fascination to American geology. "Its features are as a whole so massive and colossal, their infinite detail so subordinated to breadth of effect, their presentation of the great elements of geological structure so grand, yet so simple and so clearly legible, that they may serve as types for elucidating the rest of the world. The progress of sound geology would assuredly have been more rapid had the science made its first start in the far West of America, rather than among the crumpled and broken rocks of western Europe. Truths that have been gained on this side of the Atlantic by the laborious gathering together of a broken chain of evidence would have proclaimed themselves from thousands of plateaux, cañons, and mountain ranges, in language too plain to be mistaken. No European geologist can visit these Western regions without realizing more or less distinctly what an amount of time has been wasted over questions about which there should never have been any discussion at all. This impression is renewed by every new geological memoir which brings to us fresh revelations of the scenery and structure of the Western Territories."

On the occasion of his appointment as Director-General of the Geological Survey of Great Britain and Ireland, Prof. Geikie was presented in March, 1882, by past and present students of the geology class in the University of Edinburgh with an illuminated address, recording their sense of loss on his leaving the university; referring to the distinguished services he had rendered the science; recognizing the signal success with which he had maintained the reputation of the Scottish school of geology, and of Edinburgh; and expressing the sympathy and affection with which they regarded him. Prof. Geikie responded in similar spirit, and said that he believed he was the first in Scotland, if not in Britain, to organize a practical class for the study of mineralogy and the microscopic investigation of rocks. He had tried always to make the cultivation of field geology a prominent part

of the work of the class; and some of their pleasantest associations had been among the glens of the Highlands and the hills and shores of the Lowlands.

Prof. Geikie is a prolific writer on all subjects relating to geology. When he was appointed in 1871 to the chair in Edinburgh he had the whole department to organize—a difficult task, but also an educating one—and to that, says Nature, we are indebted for the undisputed superiority which he has displayed in his Text-Book, as well as in his other educational writings, "such as the Class Book, a very model of clearness, whereby it has been once more demonstrated that those only are qualified for writing elementary books who are in the fullest possession of the whole matter." Likewise he is the author of small books or primers on Physical Geology and Physical Geography, of which some hundreds of thousands of copies have been sold, and which have been translated into most European languages, as well as several Asiatic tongues. He is also author of numerous memoirs in the Quarterly Journal of the Geological Society, the Transactions of the Royal Society of Edinburgh, the memoirs of the Geological Survey, the Quarterly and North British Reviews, Nature, etc.; of the Story of a Boulder, 1858; in conjunction with the late Dr. George Wilson, of The Life of Prof. Edward Forbes, 1861; of the Phenomena of the Glacial Drift of Scotland, 1863; The Scenery of Scotland viewed in Connection with its Physical Geology, 1865, and a new edition, largely rewritten, in 1887; in conjunction with the late J. B. Jukes, of a Student's Manual of Geology, 1871; of the Science Primers of Physical Geography, and Geology, 1873; Memoir of Sir Roderick I. Murchison, with notices of his Scientific Contemporaries, and of the Rise and Progress of Palæozoic Geology in Britain, 2 vols., 1874; of the Geological Map of Scotland, 1876; of the Class Book of Physical Geography, 1877; of Outlines of Field Geology, 1879; of Geological Sketches at Home and Abroad, 1882; of A Text-Book of Geology, 1882; of A Class Book of Geology, 1886. Prof. Geikie was associated with Sir Roderick Murchison, in the Scottish Highlands, in the preparation of a memoir of that district, and of a new Geological Map of Scotland, both published in 1861. He was elected to the Royal Society before reaching the age of thirty years, and is now its foreign secretary. He is past President of the Geological Society. He received the Murchison Medal of the Geological Society in 1881, and has been twice awarded the McDougal Brisbane medal of the Royal Society of Edinburgh. He is an associate of the Berlin Academy, of the Royal Society of Sciences at Göttingen, of the Imperial Leopold Caroline Academy, of the Imperial Society of Naturalists at Moscow, and a correspondent of the French Academy of Sciences.

CORRESPONDENCE.

THE FIRST TRANSATLANTIC STEAMER.

Editor Popular Science Monthly:

SIR: On page 424 of the January number (1893) of The Popular Science Monthly is given a *précis* of the log of the ship Savannah, which is correct; but the heading, The First Transatlantic Steamer, is totally wrong.

The Savannah was not the first transatlantic steamer, but a *sailer*, with propelling contrivances to be used in smooth water; moreover, she did not carry fuel enough to take her across to England by steam, and she proved a failure as far as transatlantic steam navigation was concerned. All this is proved by her log. The transportation of a steam engine and paddles by a sailing ship does not constitute her a steamer in the true sense of the word.

The first genuine pioneer steamship to cross the Atlantic Ocean by steam alone, and the first complete success in steam navigation, was the steamship Royal William, built at Quebec, Canada, through the enterprise of Canadian merchants, by Canadian shipbuilders, and with Canadian money. It was sent across the Atlantic Ocean in 1833, and proved to be the origin of the Cunard line of steamers. It was sold to the Spanish Government for a man-of-war and called the Isabela Segunda, being the first war steamer in the world, and was engaged in action against the Carlists. Some years later she went to Bordeaux, France, for repairs, but her hull was condemned and a new vessel was built on her model, in which the old engines were placed. This vessel went into service under the same name, but was wrecked in 1860 on the coast of Algeria, where no doubt the Royal William's engines may now be found.

I send you our Transaction, No. 20, containing the whole *attested* account of the Royal William, which is incontrovertible proof of what I say, and proves that the honor of first transatlantic steam navigation belongs to Canada and Quebec city, and not to the United States at all.

The Savannah was a fraud, a veritable sailing ship, built as such, subsequently took on an engine and propelling contrivances which could only be used in smooth water; with these she steamed *out of port*, then *sailed* to England, steaming only eighty hours, not consecutively, out of a passage of twenty-nine days and a half, but took good care to let down her paddles on coming into port, making believe that she steamed the whole way across the Atlantic, and, moreover, repeated this performance at every port she visited. The Royal William was the first veritable transatlantic ocean steamship.

F. C. WURTELE,
Librarian of the Literary and Historical Society of Quebec.

QUEBEC, *March* 25, 1893.

[All that Mr. Wurtele says of the defects of the Savannah appears on the face of the article we published. The title, if not strictly accurate, reflects current speech on the subject. We are glad to give our Canadian neighbors the credit that is their due in the matter of the Royal William.—ED.]

FOOD OF THE GARTER SNAKE.

Editor Popular Science Monthly.

SIR: In your February number, Mr. Alfred G. Mayer, in speaking of the habits of the garter snake, says that he is not aware of their eating birds or mice. They will, when kept in captivity, at least, eat the latter animals. I once kept one under observation for a considerable time, and its only food was mice. These it ate with apparent relish and in greater numbers than I supposed at first would be eaten. Its mode of capturing and killing a mouse was also different from that by which the snakes secure frogs. It lay quietly coiled, with its head slightly elevated, for a little time after the mouse was put into the box. The latter ran to and fro over the coils of the snake, as though utterly unaware of the presence of an enemy. Presently the snake darted forward, seized the mouse in its jaws, and with lightning-like rapidity *coiled itself around its body*—the head of the snake and the mouse being invisible from without the coil. The quickness of the movement was decidedly startling. After about one minute the coils began to slacken, and the mouse rolled out, completely crushed and quite dead. The snake moved away, but within an hour devoured it. This snake was *Eutænia sirtalis*. I have not found any one else who has seen it take its food in this way, and can not account for the actions of this particular specimen. A full-grown copperhead, under similar conditions, behaves very differently. With marvelous rapidity it would shoot its head forward, apparently merely touching its victim. The mouse would give a faint squeak, and in thirty seconds would be dead and perfectly stiff. His snakeship then devoured it at his leisure.

WILBUR S. JACKMAN.

COOK COUNTY NORMAL SCHOOL, CHICAGO, ILL.

EDITOR'S TABLE.

SOCIAL PROBLEMS.

WE have read with considerable interest a book by Mr. Henry M. Boies, elsewhere noticed in this number, having for its title Prisoners and Paupers. We have read it not only with interest but with sympathy, for Mr. Boies is much in earnest, and his aim is the noble one of serving the community by checking the evils of criminality, pauperism, and mental and physical degeneration, which in these latter years have been assuming so threatening proportions. With much that the author says we entirely agree, and many of his suggestions seem to be of a very practical and useful kind. Here and there is perhaps a touch of undue national vainglorionsness which does not harmonize very well with the fact that the book is in the main a revelation of the weaknesses of American society. Here and there, too, the author seems to contradict himself, as where, on page 95, he speaks of the upward tendencies in this country being more powerful than the downward ones, and afterward (page 258) says that, while "we are listening to the delusive enchantments of physical prosperity and national growth, millions of remorseless *teredos* from the lower depths are honeycombing the hull of our ship of state"; and again (page 259) that "the condition politically is desperate, but not hopeless"; and again (page 278) that "signs of a general degeneracy are attracting public attention." The important thing, however, is that, in the statements and observations he makes, Mr. Boies gives us plenty to think about, and makes it very plain that something more than thinking is called for—that prompt, strenuous, and intelligent action is an urgent necessity of the moment.

It all amounts to this, that, while the men of this generation are eating and drinking and taking their ease, marrying and giving in marriage, running political machines, and blowing hot or cold, as the case may be, upon the stock market; while luxury is on the increase, and practical Science is recording her most magnificent triumphs, the foundations of society are being sapped by the incessant growth of unsound social elements. In early ages mankind, in only less degree than the lower animal tribes, had the benefit of the rude but effective surgery of Nature to keep them up to a certain level of physical efficiency; and in a later period the extreme severity of the laws had the effect of removing from the community large numbers of those who were least adapted for citizenship. As a result of these processes the civilization of to-day, with its more humane and philanthropic spirit, became possible; but it is now beginning to be found out that philanthropy, as heretofore practiced, is no match, so far as the physical purification of society is concerned, for the methods of Nature, as described by Malthus and Darwin, or even for the penal discipline of our forefathers. Mr. Boies fully accepts this view of the matter, as the following extract from his book will show:

"The civilized man is the product of the survival through all the ages of the strongest, most stalwart, and capable savages. In the progress of his civilization the development of the sentiment of human brotherhood and the principles of Christianity has caused an interference with the natural law provided for the extinction of the unfit by impelling the strong to maintain and care for the weak and defective. At the same time, advances in the sciences of hygiene, medicine, and surgery enable many of the unfit to survive the tests of child-

hood and disease which, in a state of nature, would be fatal. It is necessary, when humanity thus restrains the operation of the laws of Nature, that it should supply a correlative supplement to prevent disastrous consequences. If civilization and philanthropy can not permit Nature to accomplish its inexorable decrees in its own way, they must provide some other way, or finally be overwhelmed."

The practical question may therefore be very simply stated: Can a sufficient amount of public attention be concentrated on the evils that threaten us, through the disproportionate multiplication of criminals, paupers, and physically defective persons, to cause effective measures to be taken to combat those evils, and, as far as possible, extirpate their cause or causes? Mr. Boies shows clearly enough the measures to be taken, and, on the whole, we must say that we find very little to dissent from in his suggestions. He pours just denunciation on our present method of turning criminals loose upon the community after a certain term of imprisonment without the slightest guarantee, moral or other, for their future good behavior. He calls attention for the thousandth time to the evils wrought by our unwholesome methods of jail administration. "It is the unanimous testimony," he says, "of every one who is conversant with the management of county jails that they are nothing more or less than breeders of criminals, where they are, as is generally the case, committed to the superintendence of political sheriffs." Of the jails of the State of Pennsylvania—and here the author professes to speak from personal knowledge—he says: "These jails permit a promiscuous and unrestrained commingling of the most depraved and vilest professional convicts with children, accused persons, and detained witnesses, without let or hindrance. In many cases even sexes are not separated." Upon a recent visit to the jail of Sunbury, Northumberland County, the author found, among fifty-four inmates of all classes, "two bright, nice-looking boys, one thirteen and the other fourteen years old, who had been incarcerated already two months and would have to remain two months longer before trial. They were accused of stealing four bottles of ginger beer!" Along with them was a depraved and vicious-looking boy charged with attempted rape. There are, we are told, in the United States, seventeen hundred and fifty-eight county jails and only forty-four juvenile reformatories. Great Britain, on the other hand, supports over four hundred reformatories and industrial schools, and has in consequence been able to close fifty-six out of one hundred and thirteen prisons and jails within ten years. In this country during the same period there has been a constantly increasing expenditure for prisons and jails, as might be supposed from the fact stated by the author at the outset, that our criminal population has increased in almost double ratio to the general population.

The most important suggestion made by the author is, that incorrigible criminals and all the hopelessly defective members of the community who are thrown upon the public care should be segregated under conditions that shall absolutely prevent them from propagating their kind. He proposes, indeed, that the problem shall be simplified by calling in the aid of surgery "to remove or sterilize the organs of reproduction," an operation, he adds, which if "bestowed upon the abnormal inmates of our prisons, reformatories, jails, asylums, and public institutions, would entirely eradicate those unspeakable evil practices which are so terribly prevalent, debasing, destructive, and uncontrollable in them." The proposed application of this remedy will be considered by most too sweeping; but as regards incorrigible criminals, particularly those whose crimes take the form of violence and lust, it will not be

long, we believe, before public opinion will sanction its employment in their case.

The conclusion of the matter for the present is, that society is taking far too little interest in the questions which Mr. Boies so ably and earnestly discusses. It must be aroused from its easy-going indifference, or our boasted civilization will not be worth many generations' purchase. Philanthropy has taken the job of keeping up the standard of the human race out of the hands of natural selection; and it now devolves upon it to show that, aided by science, it is equal to its self-imposed task, and can indeed accomplish results that never could have been accomplished by the operation of unconscious laws.

LITERARY NOTICES.

PRISONERS AND PAUPERS. A Study of the Abnormal Increase of Criminals, and the Public Burden of Pauperism in the United States; the Causes and Remedies. By HENRY M. BOIES, M. A. New York: G. P. Putnam's Sons, 1893. Pp. 318. Price, $1.50.

MR. BOIES had peculiar facilities for the production of such a work as this and he has used them ably. In his preface he says that he has in this work not only endeavored to give a general view of the subject as it appears in this country, "to emphasize the waste of human sympathy and public funds which results from what appears to be inconsiderate and misdirected methods of treatment," but he proposes a most feasible—he says, "positive remedy."

The eleventh census of the United States, which is now being published, "furnishes statistics of a national growth in numbers, wealth, and general prosperity unparalleled in the history of civilization." Nevertheless, this census, says the author, makes some disclosures which are "appalling in the highest degree to our confidence in the future." One of these is the extraordinary increase in the criminal classes; and he shows that while in 1850 the proportion of criminals was 1 in 3,500 of the population, it increased in 1890 to 1 in 786·5, or 445 per cent; while the increase of population in the same period was only 170 per cent.

Mr. Boies claims that "such a disproportion can not continue indefinitely without a relapse into barbarism and social ruin." And he explains his statement by telling that such a condition of affairs does not exist in any other civilized nation. He attributes the first cause for crime and pauperism to the unnatural increase of intemperance; the second, "the crowding of the people to the centers."

The third cause lies in the existing laws for the punishment of criminals and the unintelligent manner in which they are administered. And having thus briefly summarized the conditions of paupers and prisoners generally and the causes for their existence, the author reviews the awful criminal condition of Pennsylvania, and in the sixth chapter begins an examination of the classes which form the prison and pauper population of the country.

In this part of the work it is stated that that portion of the population which is foreign-born, or having one or both parents foreign-born, furnishes over one third of the criminals and three fifths of the paupers of the country, whereas they constitute only one fifth of the whole number. From this the author concludes that to avert the danger "which has become imminent, and threatens our very existence, . . . Congress must regulate immigration as the initial remedy."

The excessive increase of criminals from the negro population occupies the next chapter, and the anomalous proportion of criminals among the population of African descent is so startling that Mr. Boies analyzes the causes very minutely. It appears, he says, that although "they constitute less than 13·51 per cent of the total population, yet they contribute one third of our convicts, though only 8·8 per cent of our paupers." Further on he says that this alarming increase "is quite as important and threatening as the foreign element," which has been considered. The cause for this disparity of criminals and paupers he claims is that "a ruling white minority (in the South), possessing the wealth, stands over a black majority which is paid for their labor actually less than the fairly comfortable subsistence which they received as slaves, and denies to them every right of equality. . . . This is as hostile to true Americanism as was slavery." And he continues,

that as a remedial measure, "Congress must therefore enforce . . . the protection of the colored race in the enjoyment of the rights it has conferred upon it in the face of the world."

In the chapter, Intemperance as a Cause, Mr. Boies claims that alcoholic drink is the direct or indirect cause of 75 per cent of all the crimes committed, and of at least 50 per cent of all the sufferings endured on account of poverty, and that "the terrible effects of this curse of humanity are displayed to all the elements of our population, the native, the foreign, the colored, and the urban alike." As one of the remedies against intemperance he suggests the establishment of cheap coffee and tea houses and social halls, after the fashion of those established by the Salvation Army in England; and he adds that "as the way to a man's heart is through his stomach," give him good, cheap food, and his desire for stimulants will cease.

The author entirely disapproves of the present general conditions of the arrest, prosecution, and imprisonment, or rather the manner of imprisonment, of criminals. He claims that the penal code should be reorganized, and that more consideration should be shown to "youthful delinquents;" for "county jails are nurseries of crime," and he attributes this to the "wrong management of the prisoners." "No State," he says, "should tolerate" "the infamous jails as they at present exist in county towns." And, "until the whole penal system is reorganized upon the basis of common sense," he offers some excellent suggestions as to the segregation of the different types of prisoners—the one from the other, as well as to how the number of prisons could be and should be lessened.

The work is illustrated with fourteen plates, and is a most valuable addition to the social and economic literature of the nation.

THE GREAT COMMANDERS SERIES. Edited by General JAMES GRANT WILSON. New York: D. Appleton & Co.

ADMIRAL FARRAGUT. By Captain A. T. MAHAN, U. S. N. Pp. 333. Price, $1.25.—GENERAL TAYLOR. By General O. O. HOWARD. Pp. 386. Price, $1.50.—GENERAL JACKSON. By JAMES PARTON. Pp. 332. Price, $1.50.

THE issue of what gives promise of being a very attractive series of biographies has been begun under the above general title. The first volume is a life of Admiral Farragut. The career of the most celebrated of America's naval heroes is sufficiently picturesque to warrant its being given the leading place. Captain Mahan's account of it is of a popular character, being neither a monograph on naval warfare on the one hand nor a juvenile story on the other. A few pages suffice to tell of Farragut's parentage, birth, and his meeting with Commander Porter, which determined the course of his life. His boyhood, before the beginning of his naval career, was too brief for much incident, for his warrant as midshipman dates from the middle of his tenth year. The record proceeds with Farragut's first cruise on board the Essex during the War of 1812. A dozen somewhat eventful years followed, bringing the young man to the rank of lieutenant. The years from 1825 to 1860 take comparatively little space, for they represent mostly the routine service of a naval officer in time of peace. Then come his grand achievements in the civil war—the New Orleans expedition, the operations at Vicksburg and Port Hudson, and the entrance of Mobile Bay. These events are described with much detail and vividness, and the several operations are illustrated by charts. A short chapter is devoted to the admiral's five years of life after the war, and a sympathetic estimate of his character closes the volume.

In the life of Zachary Taylor is given a record rich in those details which often reveal more of the subject's character than his most formal and deliberate acts. We have a glimpse at his early life in the frontier territory near Louisville, Ky., then an account of his first few years in the army, his service in the Northwest Territory during the War of 1812, his campaigns against the Indians in Florida and elsewhere, all leading up to his magnificent achievements in the Mexican War. His part in this contest is described in a sympathetic and picturesque manner. Close upon the heels of it comes his election to the presidency, and a sketch of his administration, of little over a year, brings his life to a close.

In James Parton's biography of Jackson is seen the hand of a master historian. Vigorous, as befits the history of such a strong personality, it is everywhere judicious, faith-

ful, and conscientious. Jackson's faults and autocratic acts are not concealed, while his sterling qualities and remarkable achievements are set forth in due prominence. The account of Jackson's campaign in defense of New Orleans is given large space in the volume. It is told with much vivid detail, and has the fascination of a tale of brave and forceful deeds, which it is. This book is notable, too, as being the last literary labor of its author, who passed away two months after it was completed.

The series is to be continued with lives of Washington, Greene, Sherman, Grant, Lee, and many others.

THE INDUSTRIAL ARTS OF THE ANGLO-SAXONS. By the Baron J. DE BAYE. Translated by T. B. HARBOTTLE. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1893. Pp. 135, 4to. Price, $7.

THIS work, which is illustrated with thirty-one cuts in the text and seventeen full-page engravings, although of considerable value to archæological students, does not shed much ethnographic light. As a matter of fact, all attempts at an arrangement of antique arts and industries must to a certain extent be arbitrary and artificial, as chronological classification *can not* be fully carried out in the present condition of archæological research. Baron de Baye claims that the Jutes occupy the first place, chronologically, among the invading barbarians of Great Britain. The Saxons and Angles followed soon afterward, and, according to the author, they all settled in Kent, in which county the most perfect archæological specimens of the ancient Anglo-Saxon industries are found. The baron uses Eutropius, Ptolemy, and Tacitus very freely in his proofs of the German ancestry of the early Britons; but it is an incontestable fact that long before the advent of the Anglo-Saxon barbarians, the Kelts, who were settled in Ireland, had made incursions into England. The archæological specimens of Anglo-Saxon industries which are illustrated in the beautiful volume we have under observation clearly resemble the accepted evidences of an earlier industrial condition among the Irish Kelts, and, more distinctly than the authorities quoted by Baron de Baye, assert their parentage as Keltic and not Germanic.

Apart from this too frequent error of the ethnographer, the author has compiled a very valuable addition to the archæological literature of England. The chapters on Anglo-Saxon fibulæ are not alone interesting but important, although they stamp the evidence of origin as Scandinavian rather than German. In these chapters the author proves with tolerable clearness an archæological point which has occupied the attention of *savants* for centuries, for he shows that the fibulæ which have been discovered in Kent and the Isle of Wight are of continental origin, and precisely similar in construction to the ornaments of Gothic manufacture which have been found in the barbarian cemeteries of the continent. This discovery at once establishes a proof of intercourse, and illustrates the artistic influence exerted over that part of Britain which was near to France; while in other parts of the work we have, upon comparison with the catalogue of the Museum of the Royal Irish Academy, distinct evidences of a Keltic origin for the industrial arts of the early Britons.

The author's analysis of the uses of the beads and crystal balls which have been found in the graves of the Anglo-Saxons is very interesting. In Nenia Britannica it is claimed that they were used for occult purposes, whereas Mr. Roach Smith is of opinion that "all the objects exhumed are capable of a perfectly simple explanation." Baron de Baye, however, asserts with somewhat of authority that they were used as talismans against sickness and "to neutralize the force of the enemy's blows." The work is excellently printed and got up, and the plates and references will be found to be of exceeding interest to ethnographical students.

FAITH-HEALING, CHRISTIAN SCIENCE, AND KINDRED PHENOMENA. By J. M. BUCKLEY, LL. D. New York: The Century Company. Pp. 308.

BESIDES the subjects named in the title, those of Astrology, Divination, and Coincidences; Dreams, Nightmare, and Somnambulism; Presentiments, Visions, and Apparitions; and Witchcraft, are treated of in this volume. In his discussions the author has adopted certain principles as working laws,

namely: "That before endeavoring to explain how phenomena exist it is necessary to determine precisely what exists; and that so long as it is possible to find a rational explanation of what unquestionably is, there is no reason to suspect, and it is superstition to assume, the operation of supernatural causes." His course, therefore, is to ascertain the facts and find a common-sense explanation for them. In investigating phenomena, some of which it is claimed are connected with religion and others with occult forces, it is necessary to proceed without regard to the question of religion. We look more closely at the chapters on Faith-healing and Christian Science and the Mind Cure as relating to the most vital subjects. In questions of faith-healing allowances must be made for the operation of natural causes, unobserved or concealed, for the excited minds of witnesses, and for other circumstances that mask the real facts; but, after all deductions have been made, the author believes it must be admitted that "most extraordinary recoveries have been produced, some of them instantaneously, from diseases in general considered incurable by ordinary treatment, in others known to be curable in the ordinary process of medicine and surgery." The cases remaining to be accounted for are those in which the effect is unquestionably produced by a natural mental cause, and those in which the operation of occult causes is claimed. In these cases, of both classes, subjective mental states are important factors. With or without belief they can produce effects either of the nature of disease or cure. Active incredulity is often more favorable to sudden effects than mere stupid, acquiescent credulity. Surprise at seeing an unexpected effect may lead the mind to succumb to the dominant idea. Concentrated attention, with faith, can produce powerful effects; may operate efficiently in acute diseases, with instantaneous rapidity upon nervous diseases, or upon any condition capable of being modified by direct action through the nervous or circulatory system. Cures may be wrought in diseases of accumulation with surprising rapidity where the increased action of the various excretory functions can eliminate morbid growth. Certain inflammatory conditions may suddenly disappear under similar mental states, so as to admit of helpful exercise; which exercise, by its effect upon the circulation, and through it upon the nutrition of diseased parts, may produce a permanent cure. The mind cure, apart from the absurdities associated with it, and from its repudiation of medicine, has a basis in the laws of Nature. The pretense of mystery, however, is either honest ignorance or consummate quackery. All the practitioners are unable to dispense with surgery where the case is at all complex and mechanical adjustments are necessary, and they can not restore a lost member; but in certain displacements of internal organs the consequence of nervous debility, which are sometimes aided by surgery, they sometimes succeed by developing latent energy through mental stimulus. The claims of Christian faith-healers to supernatural powers are discredited by facts which are cited; and faith cure, technically so called, as now held by many Protestants, is pronounced "a pitiable superstition, dangerous in its final effect." It is harmful because it tends to produce an effeminate type of character which shrinks from pain, and to concentrate attention upon self and its sensations. It sets up false grounds for determining whether a person is or is not in favor with God; it opens the door to every superstition. Practically it gives support to other delusions which claim a supernatural element. It diminishes the influence of Christianity by subjecting it to a false and inconclusive test; diverts attention from the moral and spiritual transformation which Christianity professes to work; destroys the ascendency of reason; and irresistibly tends, in some minds, to mental derangement. "Little hope exists of freeing those already entangled, but it is highly important to prevent others from falling into so plausible and luxurious a snare, and to show that Christianity is not to be held responsible for aberrations of the imagination, which belong exclusively to no race, clime, age, party, or creed." The relation of the mind-cure movement to ordinary medical practice, Dr. Buckley concludes, is important. "It emphasizes what the most philosophical physicians of all schools have always deemed of the first importance, though many have neglected it. It teaches that medicine is but occasionally necessary. It hastens the time when patients of dis-

crimination will rather pay more for advice how to live and for frank declarations that they do not need medicine than for drugs. It promotes general reliance upon those processes which go on equally in health and disease. But these ethereal practitioners have no new force to offer; there is no causal connection between their cures and their theories. . . . Recoveries as remarkable have been occurring through all the ages as the results of mental states and Nature's own powers."

A DICTIONARY OF TERMS USED IN MEDICINE AND THE COLLATERAL SCIENCES. By the late RICHARD D. HOBLYN, M. A. Oxon. Twelfth edition. Revised throughout, with numerous Additions, by JOHN A. B. PRICE, B. A., M. D., Oxon. New York: Macmillan & Co. Pp. 822. Price, $2.25.

THE appearance of the twelfth edition of this dictionary, with revisions and additions, which include even the terms used in the very modern science of bacteriology and bring the book fully up to date, places a useful work at the disposal of physicians and students. It is, of course, not exhaustive; but it contains descriptions of all the ordinary terms relating to medicine, and these, although necessarily brief, are full enough for all practical purposes. Under the head of poisons, eight or nine pages are devoted to a classification of the commoner ones, in which the symptoms and most approved methods of treatment are given.

Its small size and good print make the contents of the volume readily accessible, and the names on the title-page are sufficient guarantees of accuracy.

A MANUAL OF PRACTICAL MEDICAL AND PHYSIOLOGICAL CHEMISTRY. By CHARLES E. PELLEW, E. M. New York: D. Appleton & Co. Pp. 314. Price, $2.50.

WITH the recent attempts to regulate the conferring of medical degrees by means of State legislation has come a tendency in the more prosperous medical schools to make their curriculums even more extended than the law requires. One of the most important innovations in this line has been the incorporation into the regular courses of a system of laboratory work, by means of which each student is given facilities for the actual chemical and microscopic study of the proximate principles, the elements entering into the composition of the human body and its secretions, and the reactions and histological characteristics produced by various pathological conditions, which are of value in diagnosis. The study of these subjects, in a practical way, has until quite recently been confined, in this country at any rate, to a few physiologists and post-graduate workers, so that an elementary text-book suited to less practiced students became a necessity. Mr. Pellew's book was designed to fill this need. Its treatment of the subject is neither original nor exhaustive, but it is very well adapted to the use of elementary students. It is printed on heavy paper, and contains several well-prepared plates and numerous line drawings.

ETHNOGRAPHISCHE BESCHRIJVING VAN DE WEST EN NOORDKUST VAN NEDERLANDSCH NIEUW-GUINEA (Ethnographical Description of the Western and Northwestern Coasts of Dutch New Guinea). By F. S. A. DE CLERCQ and J. D. E. SCHMELTZ. One vol., 4to, pp. 300, plates xlii. Leyden: P. W. M. Trap.

THIS magnificent work describes the collections made by Mr. F. S. A. de Clercq in New Guinea in the years 1887 and 1888, which are now in the Royal Ethnographic Museum at Leyden, Holland. The descriptive portion of the work is mainly by Dr. J. D. E. Schmeltz, conservator of the museum. The book is a model of its kind. It is furnished with a full list of all authorities quoted, a list of all places mentioned, an excellent map, and admirable indices—all necessary, but, unfortunately, often omitted in ethnographic writings.

The main portion of the work is divided into three parts. In the first we have a description of each object—size, form, material, details, and provenance—with references to passages in any author where similar objects have been described or illustrated. Where necessary for comparison or illustration, sketches are introduced into the text. The objects described are divided into five groups: *a*, dress and adornment; *b*, houses and domestic utensils; *c*, objects used in trade, fishing, etc.; *d*, weapons; *e*, objects used on festal occasions, ceremonies, etc. The plates, more than forty in number and mostly colored, represent the objects de-

scribed admirably. Among some of the more striking and interesting may be mentioned handsome headdresses of feathers, ear decorations of tortoiseshell, boar-tusk and red-bean breastplates, stone pounders for sago, paddles, drums, spears barbed along both edges, narrow shields elaborately decorated with carving and color, quaint carved figures, and wooden headrests or pillows. Two plates are devoted to portraits showing hairdressing, tattooing, and face ornaments. The coloring of the plates is done in Trap's best style. The second part of the work is a study in geographical distribution of the objects. A brief ethnographic sketch of New Guinea (based on Serrurier's classification) is presented. Four tables are then given in which the distribution of each type of objects is shown, and the fact is made plain that there are distinct areas of culture in the great island. A study of some ten pages follows upon the relationships shown by the ornamentation of the various objects. In 1884 Van Rye prepared a complete bibliography of New Guinea; in Part III of this work Dr. Schmeltz completes this to the present date.

Messrs. de Clercq and Schmeltz are to be congratulated upon their work. The Netherlands Government is also to be greatly commended for the encouragement and aid which it has given to its publication. Public interest in ethnography is keen and intelligent in Holland.

GEOLOGICAL SURVEY OF MISSOURI. Vol. II: A Report on the Iron Ores of Missouri. Pp. 365. By FRANK L. NASON, Assistant Geologist. Also Vol. III: A Report on the Mineral Waters of Missouri. Pp. 256. By PAUL SCHWEITZER, Assistant Geologist. Published by the Geological Survey, Jefferson City, 1892.

THESE volumes, which are issued by Arthur Winslow, State Geologist, are exhaustive treatises upon the subjects of their titles. Mr. Nason complains in his preface that the lack of railroads and good public roads made the survey difficult; but, nevertheless, his patient work, assisted by the cooperation of the intelligent citizens of the iron-ore districts, enabled him to compile a most interesting as well as valuable report.

In Chapter X of the Report on the Mineral Waters of Missouri Prof. Schweitzer makes some very interesting comparisons between the domestic waters and the mineral waters of Europe, which will be read with profit by those engaged in the merchandising of the Missouri waters. In these comparisons, the author was largely assisted by the observations of Prof. Arthur Winslow. Both volumes are elaborately illustrated. Embodied with Vol. III is a very useful appendix, containing a bibliography of mineral waters, chronologically arranged.

THE MOUND-BUILDERS: THEIR WORKS AND RELICS. By Rev. STEPHEN D. PEET, Ph. D. Vol. I, illustrated. Chicago: Office of the American Antiquarian. Pp. 370.

DR. PEET claims that man's first appearance on the American continent was not contemporaneous with but toward the close of the Glacial period—about ten thousand years ago. As to the appearance of this prehistoric individual he quotes other students of the subject to prove that the great French archæologist is in error when he claims that man, immediately after the Glacial period, was "of great stature." His research enables him to corroborate Dr. Thomas Wilson's summing up of the characteristics of palæolithic man, viz., "He was of short stature and strong of limb."

The author says, in his first chapter, that "In Great Britain . . . we go back of the Celts and Saxons to find the Britons and the Basques, who were comparatively modern." This is an error. Authentic records prove that not only were the Celts pre-Briton, but that the nomenclature of England was derived from the Celts of Ireland and Scotland, and was, at that time, precisely similar.

The chapter entitled The Stone Grave People is of important interest. In this the author devotes several pages to an analysis of the mound-building theory as it applies to America; and from the specimens of pottery that have been taken from the stone graves he builds a probable and interesting presumption of the facial characteristics of the prehistoric dwellers on this continent. In another chapter he seems to recede from his contention that the first appearance of man in America was after the Glacial period; for he accounts for the scarcity of images, etc., in the South by the assumption that during the dissolution of the glacial forma-

tion the mastodon retreated northward, and man—"the hunters"—followed.

The chapters on the Migrations, Village Life, and Defensive Works of the Mound-builders will be read with considerable pleasure and benefit by archæological students. Dr. Peet has given the results of his research in a style that will be acceptable even to non-students. The work is profusely illustrated.

PRACTICAL POCKET-BOOK OF PHOTOGRAPHY. By Dr. E. VOGEL. Translated by E. C. CONRAD, F. C. S. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1893. Pp. 202. Price, $1.

PHOTOGRAPHY now exerts such an influence upon current literature and general events that a handbook such as that which Dr. Vogel has produced is not alone timely, but useful. One of the great difficulties under which beginners in the art of photography labor is the fact that the formulas and instructions in most guides are too many, too complex, and too incomplete. In this little volume the author has selected only the simplest and best formulas for developers, intensifiers, etc., all of which have been accepted and are used by the professors of the Royal Technical High School of Berlin.

The first chapter is devoted to an examination of the different photographic apparatus in vogue among German experts, and contains also some very useful information on photographic objectives, or the combinations of lenses that are capable of giving an optical image. Instantaneous photography is also treated in this chapter, and some simple rules by which exposures should be determined will be read with profit by both amateur and professional photographers. Among the formulas for developers, the author draws attention to a new and concentrated para-amidophenol developer, which, under the name of "rodinal," has been introduced by the Aktiengesellschaft für Anilinfabrikation. This developer only needs dilution with water to be ready for use, and "is especially excellent for instantaneous photographs."

In the fifth part of Chapter IV, Dr. Vogel gives some very simple instructions for the recovery of silver from residues, which will be useful for those who use developers, intensifying baths, etc., in large quantities. The fifth chapter is devoted to the positive processes, which are examined in brief detail.

The book is illustrated fully, and the selection of cuts and diagrams is admirably suited to the subject matter. The translator has added some important foot-notes to the general text, which was evidently written for the use of German students by Dr. Vogel.

MINERAL SPRINGS AND HEALTH RESORTS OF CALIFORNIA. By WINSLOW ANDERSON, M. D. San Francisco: The Bancroft Company. 1892. Pp. 384.

HAVING regard to the value of the investigation of balneotherapy and the scientific internal administration of mineral waters, which has gone on with great benefit in Europe for centuries, Dr. Anderson, believing that California possessed valuable mineral springs, spent several years examining and comparing the waters of that State, and gives the result of his labors in this work. It is a perfect revelation of the mineral waters of California, and apparently leaves nothing unsaid either as to their efficacy as health restorers or of their comparative value against well-known European mineral waters. Although the greater part of the work is devoted to an exhaustive analytical examination of the waters, a fund of useful information is added on the ancient uses of mineral springs, their classification, and the theory of their origin, with the therapeutics or medicinal uses of the different waters. The book is profusely illustrated with cuts of the mineral springs and of California's most famous health resorts.

ELEMENTARY TEXT-BOOK OF ENTOMOLOGY. By W. F. KIRBY, T. L. S. Second edition. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1892. Pp. 281. Price, $3.

THIS work is elaborately got up, containing eighty-seven plates and over six hundred and fifty figures, representing a pictorial library of the insect world. In his introduction Mr. Kirby gives an unusually lucid explanation of the structures and zoölogical nomenclature of the insect tribe, which he divides into four classes of animals having bodies composed of a number of joints or segments. He pays reverent tribute to the researches of Linné, who divided all the insects known

to him into seven orders in his work Systema Naturæ (1735). Fabricius (a pupil of Linné) prepared a new classification of insects, founded on the structure of the mouth, and he renamed all the Linnæan orders, even where they coincided with his own.

From these and other sources Mr. Kirby selects only the nomenclature that is modernly accepted, and he gives a most interesting study in this volume. The chapters on the *Hymenoptera* class will be found to be of more zoölogical value than any account of the habits of bees, wasps, ants, etc., that has yet been published; and as this family is, industrially, of more consequence to the public than any other of the insect class, the selection of the *Hymenoptera* species for his most elaborate history is well chosen.

The analysis of the *Lepidoptera* family is treated very exhaustively. It comprises especially butterflies and moths, and the plates at the end of the book very fully illustrate the principal members of the species.

THE STUDENT'S HANDBOOK OF PHYSICAL GEOLOGY. By A. J. JUKES-BROWN, B. A., F. G. S. Second edition, revised. London: George Bell & Sons. 1892. Pp. 666. Price, $2.25.

THIS is a recast of Mr. Jukes-Browne's Handbook of Geology, to which he has added over one hundred pages, chiefly dealing with physiographical geology and the substructure of the earth's crust. He shows pretty clearly that, although physiographical geology is in the nature of an incidental study, it is nevertheless the most perfect basis upon which to form accurate geological beliefs, and he places this part of the work, very properly, immediately following the chapters on Dynamic and Structural Geology.

Perhaps the most interesting section of the work is that devoted to the underground circulation of waters. The mechanical effects of this subterranean water circulation are very important in geological research. In England and in many parts of the Continent and America they usually consist of landslips and cave formations; whereas in Ireland and in southern Germany the shell of land above the water is oftentimes "cracked," and, becoming detached from its moorings, travels a mile or two from its original location.

In the chapter on Igneous Rocks as Rock Masses, Mr. Jukes-Browne has given some highly interesting examinations of the porphyritic deposits of Wales, Scotland, and Ireland, clearly indicating the volcanic structure of these countries. In dealing with the influence of earth movements, the author quotes Prof. Powell in connection with the probable system and time of the bed formation of Colorado, and he says: "All the facts concerning the relation of the waterways of this region to the mountains, hills, cañons, etc., lead to the inevitable conclusion that the system of drainage was determined antecedently . . . to the formation of the eruptive beds (lavas) and (volcanic) cones." The work is profusely illustrated.

THE EARTH'S HISTORY. An Introduction to Modern Geology. By R. D. ROBERTS, N. A. New York: Charles Scribner's Sons. 1893. Pp. 270. Price, $1.50.

THIS is a useful little volume, giving an interesting sketch of the methods and chief results of geological inquiry; but the author errs, in the same manner that do most English scientists and writers of scientific English bibliology, inasmuch as that he assumes that "the geology of Great Britain is indeed, in epitome, the geology of the world." In his preface he says that although individual groups of rocks may be found developed on a grander scale in one or other of the continental areas, and that "particular scenic features, more majestic and impressive, may be found elsewhere; in no part of the world can so great a variety of geological phenomena (no doubt often in miniature), and so complete a system of natural agencies, either in active operation or displayed in their results, be observed than in Great Britain." The recent geological surveys of Arizona, California, and other American States had not apparently reached London when Mr. Roberts wrote his book, for in the ascertained stratigraphical conditions of these States we have a far more generous field for geological research than the well-ventilated analysis of British geological conditions can ever display. Nevertheless, the author has compiled a valuable text-book of preliminary examination of the study of geology, and in the chapters upon Aqueous Rocks and the Deposition in Past Times, and the Volcanic

Action in Past Times, he has materially added to the existing literature upon geological research.

Three books in the series of *English Classics for Schools*, by the American Book Company, well illustrate the excellent idea on which the issue is based—which is that of presenting the best English books, of suitable size, with the accompaniment of full prefatory information concerning the subjects, environments, and authors of the works. The *Sir Roger de Coverley Papers from the Spectator* is introduced with an account of the Tatler, of which the Spectator was the direct outcome, and its characteristics, and biographical sketches of *Addison*, *Steele*, and *Budgell*, the authors of the Sir Roger de Coverley papers. To a similar edition of *Sir Walter Scott's Marmion* are prefixed a characterization of Scott's work in the poem, a description of the Scottish people of the time of the action, their customs and distinctions, an account of the significance of the battle of Flodden Field, and maps of the region and of the battle-ground. *The Second Essay on the Earl of Chatham*, by *Lord Macaulay*, is furnished with biographical sketches of the author and of William Pitt. These volumes are neat in appearance, moderate in price, and are suitable for the modest library as well as for the schoolroom.

Robinson's Arithmetics (American Book Company) have for many years had a wide use among the best American schools. In preparing new and revised editions, the object has been kept in view of retaining all the features which have contributed to their usefulness and popularity, and making only such changes as would add to their value and bring them up to date. In the *Primary* work, stress is laid upon teaching pupils to recognize numbers of objects before they are required to represent numbers by words or by figures. A valuable feature of the revision of the *Rudiments* consists in the addition of about forty pages of introductory exercises, of a general character, which adapt the book for use in a two-book series, in connection with the *Practical Arithmetic*, or it may be used without the introductory exercises, in a three-book series. The scheme of revision of the *Practical Arithmetic* has been rather one of judicious addition than of omission, and yet by an economical adjustment and by an occasional dropping out of useless matter it has been possible to add many valuable features and much new matter without materially increasing the size of the book. In the arrangement of subjects attention has been paid to placing those in sequence which run naturally and by easy stages into one another, and to giving early places to the most important and useful applications.

Ædeology, by *Dr. Sydney Barrington Elliot*, is devoted to the physiology, hygiene, etc., of the generative life of man. The volume is compiled from a great variety of sources, and is characterized by that vague generality of statement which appeals to a prurient curiosity without doing much for the enlightenment of the reader. Full and explicit instruction in the physiology of the generative system, suitably timed and adapted in the education of the young, would be of great service to society, and there is nothing in this class of publications that will take the place of it or approach it in value. (New York, St. Clair Publishing Co., 260 pages; price, $1.50.)

In the sixth edition of M. Foster's *Textbook of Physiology*, the appendix by Dr. *A. Sheridan Lea*, on *The Chemical Basis of the Animal Body*, is bound by itself as Part V (Macmillan, $1.75). It has been enlarged, and now constitutes a treatise on the chemical substances occurring in the animal body. The several classes of proteids are first described, after which the chemistry of the enzymes, or soluble unorganized ferments, is given. Certain amorphous bodies allied to proteids—mucin, gelatin, keratin, etc.—and the few carbohydrates found in the human body then receive attention. Other groups are the fatty acids and their allies, the amides and amido acids, the uric-acid group, the ptomaines, and the various coloring matters. Cuts showing the appearance of crystals of many of the substances described are scattered through the text, and the volume has a separate index and a list of authorities quoted.

A treatise on *Varicocele and its Treatment* has been prepared by Prof. *G. Frank Lydston*, M. D. (Keener). After a description of the disorder, its causes are reviewed, and

various modes of treatment, palliative and radical, are set forth. The volume has an index and a bibliography. A number of cuts illustrate the appearance of diseased parts and methods of operation.

Studies in American History, by Prof. *Mary Sheldon Barnes* (Heath, 60 cents), is a teachers' manual, consisting of a series of outlines for lessons. It is designed to direct pupils in studying history from the original materials, and to that end gives lists of authorities, with critical comments, summaries of points to be made under each head, notes, suggestions, and references for the teacher's reading. The studies are divided into seven groups, one being introductory and the others covering the history of the territory occupied by the United States from Columbus to 1892. Machine teachers had better let this book alone; it is a tool they can not handle.

An *Elementary Treatise on Trigonometry*, by *E. W. Hobson* and *C. M. Jessop*, has been issued from the press of Cambridge University (Macmillan, $1.25). It is a book for beginners in its subject, and parts are indicated which students are advised to pass over until they have been once through it. A large number of problems are given, many of them practical, and the answers are put at the end of the volume.

Having received from Prof. Kükenthal for examination some specimens of *Apus* brought from Spitsbergen, Mr. *Henry Meyners Bernard* has made a study of the species and come to the conclusion that it is a variety of *Lepidurus glacialis*, which he proposes to call *L. Spitzbergensis*. His observations of this *Apus* form Part I of a book, *The Apodidæ*, which he has contributed to the Nature Series (Macmillan, $2). In Part I, also, he undertakes to prove that *Apus* is an original crustacean easily derivable from an annelid. Going on, in Part II, the author maintains that *Apus* is, moreover, the original of all the modern crustaceans.

The Heredity of Acquired Characters is the title of a paper by Dr. *Manly Miles*, Lansing, Mich., which was published in *The Proceedings of the American Association for the Advancement of Science*. The inheritance of acquired character has been denied by Weissman, who claims the "continuity of the germ plasma as originally formulated, and all inheritable variations are assumed to be the result of fortuitous changes in the reproductive germs." Dr. Miles claims that it is impossible that a living substance, undergoing constant changes, can be "a substance of extreme stability" to "grow enormously without the least change in its molecular structure," as advanced in Weissman's theory, and he adds that the fact of the germ plasma being brought into intimate relations with the metabolism of the body plasma, the habits of the organism in modifying the general metabolism of the body must also exert an influence on the system of the germ cells, and, through their constantly changing substance, on the forms of activity that are transmitted from one generation to another. From Dr. Miles's standpoint it is an almost impossible supposition that from two germs of identical qualities and tendencies, two adult forms could be evolved, precisely alike in every detail. To arrive at such a perfect reproduction it would be necessary to have the same series of anastates in the constructive processes of every organ, and the same destructive metabolism throughout the entire period of growth, which, of course, could very rarely occur in the surrounding conditions of two individuals; but he admits that the repetition of an acquired habit for several generations, uniformly transmitted, might establish a dominant, inherited family characteristic.

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POPULAR MISCELLANY.

The Telautograph.—A new system of electric transmission was recently exhibited in New York and Chicago which promises to rival in commercial importance the telephone. This is the writing telegraph of Prof. Elisha Gray. By means of it any one can with an ordinary lead pencil on ordinary paper write a message or make a sketch and have it reproduced with exactness, in its minutest detail, in the receiving instrument, which may be hundreds of miles away. As this method of communication necessarily provides a record, and as the mistakes so easily possible in any system of oral communication can not occur, it should find a wide field of usefulness in the business world. *Fac-simile* telegraphs are almost as old as the art of telegraphy itself, but no such system has heretofore come into extended use, as they have proved unreliable in practice and have lacked the simplicity essential in any apparatus designed for general use. Nearly all previous attempts to provide autographic reproduction have depended upon synchronism

in the movement of the transmitting and receiving instruments, a condition practically impossible of realization. Unlike these earlier devices, the system of Prof. Gray does not depend at all upon the timed movements of the instruments at each end of the line, but like the telephone the transmitter positively actuates the distant receiver. The fundamental principle of the apparatus is that first applied to this purpose by Mr. E. A. Cowper, of England, some fifteen years ago; but Prof. Gray has greatly simplified the construction and given a range and flexibility to the instruments which practically constitutes a new departure in this method of transmission. The principle involved is the familiar geometric one that any plain curve, no matter how intricate, may be decomposed into component parts along two lines at right angles to each other. If, then, a point be affixed at the junction of these lines, all that is necessary to reproduce its movements is to cause two other similar lines to reproduce the movements of the first two. A point at the junction of the second lines will then travel in exact conformity with the first point. This principle is made use of in the familiar draughtsman's instrument, the pantograph, used for producing enlarged or reduced copies of an original drawing. In Prof. Gray's apparatus the transmitting instrument consists of a box provided with a leaf or table, upon which the paper, which is fed from a roll mounted upon the instrument, rests. The pencil is placed at the junction of two silk threads at right angles to each other, the farther ends of which are wound upon drums in such a way that the motion of the pencil serves to rotate them backward and forward in exact accordance with the linear components of the curves described by it. These drums have each an arm which sweeps over a series of electrical contacts, thereby sending a succession of electrical impulses into its line wire proportional to its movement. A contact playing between stops serves to reverse the current with the reversal of the motion of the drums. The receiving instrument consists of a pen mounted at the junction of two light metal arms, the movements of which are controlled by the electrical impulses sent to line by the transmitting mechanism. This control is effected by means of a gear-wheel—one for each metal arm—which is actuated by clutch-weights, which weights are in turn controlled by the current through the medium of an electro-magnet. The gear-wheels, therefore, move in one direction or the other in exact accordance with the currents sent over the line wires and give motion to the arms carrying the transcribing pen. The pen is of the ordinary form in such instruments, namely, a glass tube drawn out to a capillary bore near the point and supplied with a free-flowing ink.

Relations of Leaves and Roots.—As a result of investigations of the influence of manure on the development of roots, M. Dehérain has found that roots in unmanured ground have a larger growth than in manured, having to spread more in search of the scanty nutriment. It having been previously found that transpiration largely depends on the activity of the roots as well as on the evaporative surface, and is not, therefore, strictly proportional to leafy development, it follows that if a plant with small leafy growth evaporates relatively more water than one with more abundant foliage, it is probably due to large root-growth procuring more water. Volkens has observed that desert plants have extraordinarily long roots. M. Dehérain further points out that solar rays falling on a plant have the twofold work of assimilation and transpiration to perform, and that these are complementary. In strong, leafy plants, assimilation is vigorous, so that transpiration is limited; while in the leaves of an "anæmic" plant a large fraction of the solar energy is given to transpiration.

Folk Lore of the Kootenay Indians.—Among the Kootenay Indians of southeastern British Columbia there exist some strange ideas of mythology. Their folk lore is extremely picturesque, and bears strong resemblance to that of the earlier European and Asiatic races. The moon is regarded by them as a man, and the sun (*natā-nik*) as a woman. There was no sun in the beginning (according to the Kootenay-Indian mythology), but after the Indians had vainly endeavored to discover it, the coyote was successful in making it rise above the mountains. Another version makes the chicken-hawk cause the sun to rise, and the coyote,

getting angry, shoots an arrow which misses the sun, and causes the prairie to take fire. The man in the moon is an Indian, who chopped wood every day, *including Sunday*, whereupon the moon came down and seized him, and he has been up there ever since. In the same manner the stars are supposed to be Indians, who have "got up into the sky" from time to time; thunder is caused by a great bird, and the lightning by the arrows which it shoots. Their version of the flood is a very quaint piece of folk lore, and apparently entirely original with them. In a report of the British Association for the Advancement of Science, on the Northwestern Tribes of Canada, Mr. A. F. Chamberlain describes this legend very interestingly, and in his pamphlet, which covers almost every trait and characteristic of the Kootenays, as well as statistics of the development of their language and customs, he relates the strange history of their sociology, folk lore, physical characteristics, etc. The monograph is published at the offices of the association at Burlington House, London.

Animals for Pets.—What is required for an every-day pet, says the London Spectator, is that it shall be beautiful and intelligent; that it shall neither be too large nor too delicate; and, if a bird, that it shall sing or talk —preferably both. The limits set by size and constitution are the main consideration in the choice of pets. Yet even so, the possible range is very great, and might well extend far beyond the species which form the main body of those usually seen at home. Tame rabbits are plenty, but tame hares are rare. A charming little foreign pet for the house is the suricate, "an active and vivacious little fellow, some ten inches long, with greenish-brown fur, large bright eyes, a short pointed nose, and dainty paws, which, like the squirrel's or the raccoon's, are used as hands, to hold, to handle, and to ask for more. . . . The creature is made for a pet, and is so affectionate to its master that it can undergo any degree of 'spoiling' without injury to its temper." A larger and more beautiful creature is the brown opossum from Tasmania —the "sooty phalangist"—with fur of the richest dark brown covering its prehensile tail like a fur boa. "Its head is small, with a pink nose and very large brown eyes; and it has a 'compound' hand, with claws on its fingers, and an almost human and clawless thumb, with the aid of which it can hold a wineglass, or eat jam out of a teaspoon. That owned by the writer was, without exception, the most fearless and affectionate pet he has ever known. In the evening, when it was most lively, it would climb on to the shoulder of any of its visitors, and take any food given it. It had a mania for cleanliness, always 'washing' its hands after taking food, or even after running across the room, and was always anxious to do the same office by the hands of any one who fed it. It made friends with the dogs, and would 'wash' their faces for them, catching hold of an old setter's nose with its sharp little claws, to hold it steady while it licked its face. The staircase and banisters furnished a gymnasium for exercise in winter, and in summer it could be trusted among the trees in the garden." The American gray squirrel, the coati, the mongoose, the marmot, and the prairie dog are commended as pleasant pets in their various ways; but only one monkey—the capuchin—is thoroughly recommended as an indoor pet. No other monkey approaches it in good temper and pretty, winning ways. They all have good, round heads, with black fur on the top and light brown on the cheeks. Their faces are most expressive and seldom still, for they take deep and abiding interest in everything in or about their cages. One is mentioned which had learned to put out burning paper by beating it with its hands or knocking it against the floor. Another, if it got a match, would collect a heap of straw, strike the match, light its bonfire, and dance around it. "The capuchin is so small, so pretty, and so clever that it seems to embody all the good and none of the bad points of monkey nature."

Spinal Curvature in Schools.—The result was recently presented by Dr. Scudder, of Boston, of an investigation into the seating of thirty-five hundred schoolgirls, with especial reference to its effect on the spine. Lateral curvature of the spine, the author said, is probably due to several factors, among which are the weight of the body falling upon a weakened spine; weakness of the spine in bone, muscle, or ligament; and a position persistently out of the median antero-poste-

rior plane of the body. The author had made a careful examination of the seating in schools, and found that faulty positions are certainly induced because of the lack of adaptation of seat to pupil and of pupil to seat. It was not possible to say how much of a factor poor seating is in causing lateral curvature, but there could no longer be any doubt that it plays an important part. He favored as a counteractive measure the introduction of general neutral movements tending to develop the whole child along the lines of his natural muscular evolution, or exercises like those of the Swedish gymnastic system. Some of the participants in the discussion of the reading of the paper suggested that faulty school attitudes might be less potent in producing curvature than bad habits acquired independently of them. All agreed upon the utility of suitable exercise as a counteractive.

Contrasts in Mountain Scenery.—Writing in Appalachia from the New Hampshire mountains of his visit to the Sierra Madre Mountains, Mr. Charles E. Fay begins by describing the contrast between the two scenes, than which, he says, there can hardly be a greater one. "The cool, balsamic air, the morning sky already piled with cumulus cloud prophetic of showers in mid-afternoon, the green fields cut by teeming brooks undulating away to meet the darker forest green that drapes the varied shapes of Whiteface, Passaconaway, Paugus, and the lower slopes of Chocorua, are a striking antithesis to what we looked on there. These mountains woo you, and there is an anticipated satisfaction in the promise made yourself to stand on every one of the peaks within your range of vision, attaining them by pleasant journeys through ferny, mossy, pathless woods. But in southern California the mountains do not invite one—at least, not for their own sakes. The conditions of climbing are most unfavorable. The summer heat is intense. They lie beyond an unattractive stretch; for the grass and flowers that in spring cover in wonderful profusion the ground that slopes upward to the sudden beginning of the steep foothills have withered, and in July all is parched and barren. The scattered live-oaks in the foreground, domineered by the will of the prevailing wind, have a half-frightened air; nothing of the repose of our maples, oaks, and white pines. The mountains themselves, rising with an almost monotonous uniformity of grade, are also burned as dry as a cinder, their dead-white rocks pallidly reflecting the remorseless sunlight. Not until near the summits or deep in the cañons do you find forest trees. The dull vegetation of the slopes of lesser altitude is of a shrubbery hard to penetrate, the most common sorts being a so-called greasewood (not the plant known in Colorado by that name) and a disagreeable thorn-bush, which, however slightly broken as you force your way through it, gives forth a sticky, milk-white juice; less frequent is the manzanita, its smooth, reddish brown being prettier to the eye than yielding to the push." These slopes abound in rattlesnakes, and there are myriads of lizards or "swifts."

Amenities of Scientific Controversy.—Says the Independent, April 20, 1893: "Not on the ground of incompetency, but on the ground of courtesy and decency, we will say that there ought to be a certain overhauling of the United States Geological Survey. Our attention has been called to articles in the American Anthropologist and the Literary Northwest by William J McGee, member of the Geological Survey, criticising a geological work recently written by a competent gentleman not connected with the Survey, but who has given great attention for many years to surface geology. This review is sprinkled with such words, applied to the author of this volume, as 'idlers,' 'pitiable paupers,' 'swindle,' 'harpies,' 'parasites,' 'shyster,' 'gull,' 'vulture,' and 'betinseled charlatan.' It is a long while since we have seen so indecent an article."

The Channels of Mars.—A new explanation of the channels of Mars is offered by Mr. T. W. Kingsmill, of Shanghai, China, as follows: As Mars revolves round the sun, under the rule of gravitation, it must have tides on its surface; and since its moons are not sufficiently large to cause any sensible rise, its tides must be mostly solar. Now, the best views we have of this planet are when it is in opposition—that is, when we are interposed between it and the sun, so that we should always see it best at high tide. The writer then makes rather a strong point of

the great eccentricity of the orbit of Mars, and the consequent heavy fall it makes when plunging toward the sun. Situated farther from the sun than we are, Mars must be regarded as an older member of our system; and since it is smaller than the earth, it is only natural that its surface crust should be thicker than that of our planet. Granting this, then the internal pulp would not have such a power to compensate for the rapid fall as the earth does internally, for there would not be so much of it, so that an external compensation, assuming the crust to be too thick to alter its form, would have to take place at the surface. On the surface, of course, the water is the only power; therefore we should expect, to put it in Mr. Kingsmill's own words, "that the water in the ocean would be projected into the Martial hemispheres, and as the planet approached the sun, tides would sweep round the planet; that the canals should sometimes appear and sometimes be duplicated . . . is only, *a priori*, what might be anticipated."

Factors of a River's Character.—Where a river shall go, what kind of a channel it will cut, how much work it will do, says A. P. Brigham, in his paper on Rivers and the Evolution of Geographic Forms, are matters determined, in an infinite number of ways, by the underlying strata. A river flowing on horizontally bedded rocks will tend to have, in its youth, a narrow cañon. Alternations of hard and soft strata give, in early stages of river life, alternations of rock benches and talus slopes; and many terrace-like horizons on the sides of the valley mantled commonly by soil, have this origin. Thus a terrace may be built up or carved out, and it may consist of alluvium, glacial rubbish, or bed rock. Tilted rocks give different types of river valleys in infinite variety. These types may be said to be just now beginning to attract a fair share of the interest of geographers and geologists. They will, in years to come, afford some of the most intricate as well as most fascinating problems which are open to inquiry.

The Critical Point in a Thunderstorm.—The belief that danger from lightning ceases as soon as the rain begins to fall heavily—expressed in the words of a mother reassuring her children, "Don't cry any more, God is sprinkling the earth with holy water"—prevails extensively among the Flemish peasants. Usually, according to M. P. J. De Ridder, lightning flashes from storm-clouds at the line between the heavy rain of large drops and the finer rain—or from the edge of the heavy rain. This is always the case in cumulo-nimbus storms, and as the number of storms of that kind exceeds all others, the belief of the peasants is at least worthy of attention. In nimbus storms, on the other hand, the critical point is at the latter end. In those of them which are developed in the veil of strato-cirrus, as when the sky is slowly covered, the rain falls at first without intensity and increases gradually, with distant thunder, while the storm itself does not seem to make much headway. But suddenly the rain falls more rapidly, and the dangerous moment has come. The roar of the thunder becomes terrible, the storm ceases, and the sky is cleared.

The Agaves.—The name of aloes is commonly given to plants of peculiar appearance which have long, fleshy leaves, with spines on their tips and sides; but this does not explain why the name has been given to species to which it does not belong, such as the agave, which do not resemble them. In Central America, their real country, where they have been cultivated on a large scale from the most remote times, they are called pitu, ozal, istle, metl, maguey, etc. Probably, soon after the discovery of America, a species of agave was introduced in the south of Europe, and became quite at home there. Linnæus, not realizing that all the agaves are American, gave it the specific name of *Agave americana*. Now there are more than a hundred species on horticulturists' catalogues, but many of these are only varieties. The uses to which these plants are found applicable are constantly increasing. In the United States and Europe they are only garden ornaments. In Mexico they hold the first place as wine plants and as textile plants. The filamentous substance obtained from their leaves is known all over the world as aloes fibers. These fibers, of length and thickness depending on the variety and locality, are so elastic and durable as to be in great demand for ropes, brushes, harness, and coarse woven

goods. The national drink of the country—its wine and cider, there called *pulque*—is produced from this plant. When pulque not yet wholly fermented—then called *agua miel* or maguey juice—is properly distilled, an alcoholic drink called *mescal* is obtained. The plants are cultivated on a large scale in the lower and middle lands of which the agave is native, and the consumption and exportation have attained a great development. The maguey enjoys the advantage of flourishing where nothing else can grow; and immense tracts of sterile soil on the seacoast have been, under the stimulus of profit, made to produce remunerative crops. Yet the plant does not reject fertilizers, and those containing potash have been found very good. The elevation and climates of the several provinces varying considerably, many kinds of agave are cultivated, according to their adaptations, and have been given as many local names, which are Aztec or Spanish. Some ten varieties are adapted to produce fibers of *henequen*, or Sisal hemp—long, silky, elastic, and durable fibers suitable for rope-making or for coarse woven fabrics. Other varieties called *lechuguilla* in Mexico, having shorter and coarser fibers, furnish acceptable substitutes for hog's bristles in brush-making. These fibers are called *istle* or *tampico*. The thick and fleshy part of the root of some of these agaves—called *amole*—is used for soap, and when roasted furnishes what is considered a "savory food." The *Agave americana* is planted in Algeria for hedges. The dry flower stalks furnish materials for light buildings; and the pliant pith is made into insect paste and dressing for razor strops.

The Danger of the Celluloid Button.—An instance is related in England in which a lady was put in great danger while standing before a bright but not blazing fire by the burning of one of the fancy celluloid buttons of her dress. Experiments made by Prof. C. Vernon Boys prove that articles composed of this material are very susceptible to heat and take fire very readily. Prof. Boys advises the public to guard themselves from what is likely to be a grave source of harm, even to the extent of fatal issues, by taking the precaution of submitting to a very simple test that resembling tortoiseshell, hairpins, combs, and other ornaments, and toys. On briskly rubbing the button on cloth a strong smell of camphor is evolved. If this ready test fails, a small portion may be ignited; it will burn energetically with a flaring noise, and the fumes of camphor given off can not be mistaken. If the article is composed of other material, the smell will probably bring to remembrance that produced on burning feathers. Celluloid, it is said, may be made uninflammable and safe by mixing with it certain metallic salts—among them the chloride of tin.

Evolution of the Color of Birds.—Mr. Charles A. Keeler, of the California Academy of Sciences, has published a volume of 336 pages on The Evolution of the Colors of North American Land Birds. In explanation of how he arrives at the theories which he advances he quotes the experiments and researches of many celebrated scientists on the evolution of the colors of butterflies, goldfish, spiders, etc., and dwells particularly on the effects of climate and the laws of heredity—uninterrupted transmission, sexual transmission, and mixed or mutual transmission—as the chief elements in the evolution of the coloring of birds' plumage. Remarking, *en passant*, that the plumage of birds, confined or diseased, loses its brilliancy, and that, should the confined wild bird breed, the plumage of the offspring would be of less beautiful colors than the parent, Mr. Keeler cites Mr. Darwin, who says: "Each of the endless variations which we see in the plumage of our fowls must have had some efficient cause; and if the same causes were to act uniformly during the long series of generations on many individuals, all probably would be modified in the same manner." And in relation to the fact that there is a general constancy of coloration in the wild birds, he remarks that this uniformity of coloration is preserved by free intercrossing, and where this is prevented by isolation or migration, variations of color very frequently take place. Young birds of various species, after the autumn molt, continue through the winter to assume, by degrees, the more intense colors characteristic of the adults, without changing feather; and Mr. Yarrell says that many birds appear to become more brilliant in color as the breeding season approaches, without either molting or the

wearing away of the tips of the feathers. Of the effect of food and environment upon the colors of bird plumage, Mr. Keeler believes that the direct influence of the environment plays an important part in the evolution of colors, and regarding food he quotes Mr. Frank Beddard, who says in Animal Coloration: "If the nature of animal colors is borne in mind, it seems impossible to doubt the modifying action of food; those that are due to structural peculiarities of the parts colored (e. g., feathers of many birds), may be altered just as much as those that are caused by the deposition of pigment; for the 'structural' colors depend largely upon pigment for their manifestation. . . . When there is an obvious relation between waste matter and the skin pigments, it can not be doubted that variation only in the amount of the food may lead to color changes." Some interesting color evolutions are given in the chapter entitled The Direct Influences of the Environment; for instance, if a yellow canary is fed with cayenne pepper, it will cause the feathers to turn red; carmine was given to some canaries and the yellow feathers became white; while Amazon parrots change from green to yellow when fed upon the fat of certain fishes. Notwithstanding the exhaustive manner in which Mr. Keeler has treated the subject, he says that "the paper is written more with the hope of stimulating thought, and inciting in a new and as yet almost untrodden field of ornithological inquiry, than with the expectation of reaching definite results."

Behavior of Young Snakes.—One of the most curious matters connected with the breeding habits of certain snakes is the "egg-tooth," a small tooth fixed to the united premaxillary bones, and projecting slightly forward, beyond the edge of the upper lip. It is present only in the embryo, and is shed very shortly after the escape of the young snake from the egg. This tooth is employed by the little snake in ripping open the tough egg-covering in its efforts to escape from its prison. The young of the *Heterodon* (a snake closely allied to the copperhead) are perhaps the most amusing youngsters of the snake family. In Volume XV of the United States National Museum, O. P. Hay, in a paper entitled On the Breeding Habits, Eggs, and Young of Certain Snakes, gives a very interesting account of the singular habits of the young *Heterodon* from personal observation. Having received a consignment of twenty-seven eggs, which were supposed to be those of the copperhead snake, he watched the bursting from the tough, parchment-like egg-covering of the young snakes, and exactly eight days after the receipt they were all hatched, the length varying from seven to eight inches. "From the moment of escape from the egg all were quite active and manifested the characteristics of the adults. . . . A faint hiss was uttered, but that may not have been voluntary. One would sometimes flatten its head and body and rear up with the anterior third of its length from the ground. If one did not know well their inoffensive natures, one would be excused for fearing to handle them. An exceedingly singular habit possessed by the adults (which is also practiced by the young) is that of feigning death." On being struck or teased, they will roll over as if in the intensest agony, and then throw themselves on the back and lie there as if dead. If left undisturbed for a little while they would turn over and creep slyly away. In this paper Mr. Hay treats the peculiar appearance of the eggs of snakes, which bring forth their young alive, very interestingly, and it would seem that even in these also there is present the singular egg-tooth.

Precautions against the Lizard.—A superstition prevails among the Shuswap Indians of British Columbia that a man who sees a small lizard of a particular species is followed by it wherever he may go during the day, till at length, when he is asleep during the following night, it finds him, and, entering his body, proceeds to tear out his heart, so that he quickly dies. The late Mr. Bennett, of Spallumsheen, told Dr. Dawson in 1877 that the Indians employed by him in making a ditch for purposes of irrigation, on coming into camp in the evening, would jump several times over the fire in order to lead the possibly pursuing lizard to enter the fire and be destroyed in attempting to cross. He also noticed that they carefully tied up the legs of their trousers when retiring. If, while at work during the day, they saw one of these little lizards, which appeared to

be abundant in that locality, it would be caught in a forked twig, the ends of which were then tied together with a wisp of grass, and the butt end of the twig afterward planted in the soil. Thus treated, the lizard soon died and became a natural mummy. If, during the progress of the work, any one found and carelessly tossed aside one of these lizards, the Indians would throw down their tools and search diligently until they found it and secured it in this manner. A similar belief to the one here recorded is noticed in Nature by Mr. C. Bushe, as prevailing in Ireland, with reference to water-newts, which are there called man-eaters. One woman to whom a specimen was shown, said they were known to jump down people's throats, to their certain destruction.

Life in Morocco.—The present population of Morocco, says Nature, is a puzzle almost as difficult, although on a smaller scale, as that of China. The authors, Lieutenant-Colonel Sir Lambert Playfair and Dr. Robert Brown, of the Bibliography of the country, give 4,000,000 as an estimate, but the guesses of various authorities vary between 1,500,000 and 15,000,000. The roads shown on the map are merely mule and camel tracks made by the feet of the pack animals, unaided by any engineer. Ferries are rare, and, of course, bridges are unknown in the interior. The distribution of towns and villages is often at variance with the rules holding for civilized countries. The villages are built out of the way of the main tracks, because people never travel in Morocco for the good of the inhabitants, and it is safer to live off the path of the tax collector and the government official, who demand free food and quarters. The great number of place-names on the map of so thinly peopled a country is due to the fact that the tombs of saints are such important landmarks that they must be indicated, even if only a few persons live beside them. All the places beginning with Sidi (Lord, Master) are either actually tombs, or the tomb has formed the nucleus of the town or village. "Sok," another affix of frequent occurrence, means market-place, and many of the established sites for periodical fairs are uninhabited between the gatherings of people from far and near. Many of the place-names on the coast exist in two forms at least—the native word and its Portuguese or Spanish translation; Casabianca and Dar-el-beida (both meaning white house), for example.

Sirius and its Companion.—The slight periodical displacements of Sirius, first observed about seventy years ago, were found by Bessell in 1851 to be due to its revolution in an ellipse, the largest diameter of which is 2·4″, which is accomplished in about fifty years. Sirius was therefore concluded to be a double star, with a satellite of considerable relative importance, which, as it was not seen, was supposed to be dark. The satellite, which is not quite dark, was seen for the first time in 1862; and can now, by taking proper precautions, be found at will. The period of revolution of the group has been determined by M. Auwers at forty-nine years and between four and five months, and the orbit an ellipse, the greater axis of which is 2·42″. Hence, according to the estimated distance of Sirius, the two stars are about twenty times as far apart as the distance of the earth from the sun, or equal to the distance of Uranus. The mass of the whole system has been computed to be 5·24 times that of the sun, of which Sirius has 2·20 times and the companion 1·04 time. The orbit of the companion is larger than that of Sirius. The distance apart of the two stars, now less than 4″, will diminish for two years longer, after which it will begin to increase again, till in twenty-six or twenty-seven years it will exceed 11″. The discovery of the system and of the rate of its revolutions affords proof of the operation of the force of gravity beyond the limits of the solar system.

Origin of Cholera.—All the theories of the origin of cholera, Mr. C. Egerton Fitzgerald suggests, may be right. The disease will eventually be found to be a miasmatic one, of which the hitherto undiscovered germ can be conveyed through the air, by water, excreta, infected bodies, and clothing. What the special germ may be we as yet know not; but that it multiplies with enormous rapidity under favorable conditions of heat, moisture, and dirt there can be no doubt. Each individual as he is attacked becomes a fresh nidus, a hotbed for disease germs, which seek and require only a suitable soil or cul-

tivating medium for their propagation; but a suitable condition of the atmosphere exists only under certain exceptional circumstances. This accounts for the rapid spread of cholera among large masses, especially dirty masses, of men. Each unit of infection acts on suitable media exactly as would a particle of yeast if introduced into a mass of fermentible fluid under the requisite conditions of temperature, etc. This is the explanation of the fact that, although cholera may arise sporadically anywhere, under favorable but exceptional circumstances, it is endemic only in India, where, presumably, these requisite conditions constantly prevail. That cholera does spread principally along the lines of human intercourse, that it may be conveyed by man, by water, by fomites, may be readily conceded without affecting the contention as to its miasmatic and aërial character and method of propagation. That cholera is caused by Koch's vibrio is to the last degree improbable, and certainly unproved, and the presence of that microbe in the dejecta of cholera patients may be due simply to its finding a congenial soil there.

Progress in Practical Electricity.—The recent inaugural address of Mr. W. H. Preece, as President of the English Institution of Electrical Engineers, was devoted to a review of the progress of the practical applications of electricity during the forty years of the speaker's service in developing them. He spoke first of the extension of the telegraph; then of the oceanic service of the Eastern Telegraph Company, the greatest cable corporation in the world, whose system of 25,370 miles stretched from Cornwall to Bombay, connected the northern and southern shores of the Mediterranean with Malta, and joined the various other islands of the Mediterranean and the Levant. This company, in conjunction with the Eastern Extension and the Eastern and South African Companies, also gained access to Australia and New Zealand on the one hand, and the Cape of Good Hope on the other, the combined mileage reaching a total of 47,151 miles. There was no more perfect apparatus in existence, the speaker said, than the lightning protector, and if it ever failed to do its duty it failed from man's neglect of some simple rule or his failure to keep it in proper order. In 1892 not an accident was recorded in any high-class telegraph instrument in the whole United Kingdom. To railways, electricity had proved an invaluable adjunct—in the repetition of signals obscured from the view of the signalman, and in night signals. The number of telephones in actual use might be put down at a million. The speaker had recently devised a new form of cable which would probably quadruple the rate of telegraphic cable working to America. There was no theoretical reason why we should not converse between London and every capital in Europe, while it was not impossible to speak even across the Atlantic. Heating and cooking apparatus worked by electricity had not at present a very favorable outlook, though many appliances had been shown in operation. The electric light was essentially the poor man's light. Many efforts were being made to utilize the waste forces of Nature in producing electric currents for the economical supply of the light. There were many towns whose streets could be brilliantly illuminated by the streams running past them. The range of power transmission had been enormously extended since much higher voltages than were possible with continuous currents could be employed. Meanwhile, power transmission by single-phase alternating current had also been developed. The use of electrically transmitted power in mines had been greatly extended within the last few years, especially in America, and the use of electrical energy for working railways was making gigantic progress in the United States, while it had begun to make a serious move in the United Kingdom.

NOTES.

In his article in the April number of The Popular Science Monthly entitled Science and the Colleges, President D. S. Jordan made the statement that "it is not many years since the faculty of one of our State universities spent a whole afternoon discussing the proposition to abolish laboratory work in science." He now writes us that although the statement was given on what he regarded as good authority, he has been informed by a member of the faculty of the institution in question, who took part in the discussion, that the question was not whether laboratory work should be abolished, but simply whether, in the course leading to the degree of B. A., laboratory work should not

be made optional rather than obligatory. In other words, the movement was not in the direction of opposing laboratory work in science, but in the direction of the extension of the elective system. He therefore desires this correction to be made.

THE entertainments called the Urania Spectacles that have been given in New York and Boston during the past two winters are very successful efforts to exhibit some of the wonders of science to large audiences. They consist of numerous photo-opticon views, in which coloring and motion as well as form are shown, accompanied by an explanatory lecture. The lecturer is Mr. Garrett P. Serviss, whose ability to make the facts of astronomy interesting is well known to the readers of the Monthly. The spectacles are now three in number: A Trip to the Moon, The Seven Ages of our World, and The Wonders of America. Among the more striking pictures in the first of these are an eclipse of the sun, close views of lunar craters and cañons, and the rotating earth as it would be seen from the moon. In the second the progress of a world from a nebula to a burned-out cinder is traced; and in the last the marvelous scenery of our own land is depicted.

A SPECIMEN of volcanic dust from near Omaha, Nebraska, is described by Prof. J. E. Todd. It was from a stratum of whitish aspect, about eighteen inches in thickness, found in the bluffs facing the Missouri River. It has the same general characteristics as the volcanic dust which has been found in quantity along the Republican River, in southern Nebraska, and in Knox, Cumming, and Seward Counties in the same State; but it differs in being stained with oxide of iron and the sharp angular grains coated with carbonate of lime. This locality is the most eastern exposure of the volcanic dust stratum which is found scattered over the most of Nebraska.

THE summer school has now been made an integral part of the university at Cornell, and will be open for 1893 with courses considerably enlarged in scope. Without excluding others qualified to take up the work, these courses are offered for the special benefit of teachers. They are open to women as well as to men, and the same facilities for work are afforded to those students as to the regular students of the university. Every opportunity will also be afforded for original research. Addresses will be delivered similar to those given in 1892 by President Schurmann and ex-President White. The session will continue from July 6th till August 16th.

THE sixth session of the Marine Biological Laboratory, Woods Holl, Massachusetts, will begin June 1st and continue till August 30th. The Laboratory for Investigators will be open during the whole time, and in it twenty special tables will be provided for those who are prepared to begin original work. An elementary course in vertebrate embryology will be introduced, with studies mainly of the fish-egg, conducted by Mr. Lillie and Prof. Whitman, to open July 5th and continue six weeks. The Zoölogical Laboratory for Teachers and Students will be open during the same time, with regular courses in zoölogy and microscopical technique, in which students will be permitted, under special conditions, to begin their individual work as early as June 15th. The Botanical Laboratory will be opened July 5th for study of the structure and development of types of the various orders of cryptogamic plants, giving special attention to the marine algæ. A department of laboratory supply has been established, to fill orders from a distance, in which a considerable number of species are kept in stock. The laboratory is under the general direction of Prof. C. O. Whitman, with whom are eleven professors in special branches, and other assistants.

THE opinion expressed by Mr. Alfred G. Mayer, in his article on the Habits of the Garter Snake, published in the Monthly for February, that snakes, as feeders on frogs and toads, are therefore friends of insects and indirectly enemies of leaves, is criticised by Garden and Forest as a dangerous generalization, "for, although the snakes will eat frogs and toads, as well as anything else in the line of small animals that they can master, they also eat a great many insects, and they could not, under any circumstances, in justice, be called protectors of insects."

THE valuable memoirs of T. A. Conrad on the Tertiary fossils of the United States have become very rare, and are practically out of the market. Yet the work is of great importance to students. The idea of reprinting the work has accordingly found favor. A reprint of the volume on the Eocene is contemplated by Mr. Gilbert D. Harris, of the Smithsonian Institution; and the Wagner Free Institute of Science, of Philadelphia, proposes to reprint the volume on the Miocene—the Medial Tertiary—with photogravure reproductions of the original plates and an introductory chapter and a table showing the present state of the nomenclature of the species; the whole forming an octavo volume of about 150 pages, with 49 plates. Subscriptions are asked for 150 copies, at $3.50 each.

MR. JOSEPH E. CARNE, Curator of the Mining and Geological Museum at Sydney, Australia, has been appointed a geological surveyor.

RESEARCHES into the conditions of the life of micro-organisms have shown them to be variously adapted to considerable diversities of temperature, and some of them to be adapted to great ranges. Forster and Bleekrode have found a few species containing

immense numbers of individuals, and living in various media, capable of developing at the freezing point. One of them, a sea-water species, produces phosphorescence at that temperature. It is well known that to preserve meat and other articles of food successfully it is necessary to employ a much lower temperature than that of the melting of ice, and experience has further shown that this is best done when the atmosphere is deprived of moisture.

ELECTRIC currents were proved many years ago to exist in plants; and Kunkel was led to think, by his experiments, that they were caused by the mechanical process of water-motion, set up on application of the moist electrode. A new investigation of the subject has been made by Herr Haaske, and he concludes that it is unquestionable that changes of matter of various kinds are concerned in the production of the electric currents, especially oxygen-respiration and carbonic-acid assimilation; and that while water movements may possibly share in their production, their share is certainly only a small one.

MR. KEDAMATH BASU has observed that under the influence of enlarged education and refinement, tattooing and the use of red paint on the forehead and crown are diminishing among the women of Bengal. These fashions still persist in the Northwest Provinces, along with the insertion of thick and heavy wooden plugs in the lower lobes of their ears.

A SPECIMEN of ruthenium, weighing two kilogrammes, prepared by M. Joly, was recently exhibited in the French Academy of Sciences. The metal is very hard and brittle, having a specific gravity of 12, and melts at the temperature of the electric arc. It is usually found associated with iridium, palladium, rhodium, and osmium, in platinum ores.

HERR DU BOIS-REYMOND has shown, in a communication to the Physiological Society of Berlin, that a sensation of heat follows the immersion of the hand in a receiver containing gaseous carbonic acid. A like effect is produced by other gases which do not enter into the composition of the air. The heat sensation may be compared with that produced by a temperature of 68° Fahr. in the air. The phenomenon results from a stimulation of the nerves sensitive to heat.

EXPERIMENTS are described by Herr Wesendonck, the object of which was to determine whether electrification is produced by the friction of gases. While ordinary air gave considerable charges, negative or positive, according to the adjustment of the apparatus, no electrification was produced when the air had been previously freed from dust and moisture. Oxygen behaved in the same way. Carbonic acid, evaporated from the liquid state, imparted a strong positive charge, which was, however, reversed as soon as the cold led to the precipitation of watery vapor. Ordinary atmospheric dust was found to electrify the brass negatively, and the charge was increased by previous drying. It seems, therefore, that pure gases are incapable of producing electrification by friction, and that the effects observed are conditioned by the presence of solid or liquid particles.

AN account of a thunderstorm in which the rain was mixed with live land mussels, which is said to have occurred at Paderborn, Germany, in August, 1892, is published in Das Wetter. A yellowish cloud attracted the attention of several people, both from its color and the rapidity of its motion, when suddenly it burst. A torrential rain fell with a rattling sound, and immediately afterward the pavement was found to be covered with hundreds of the mussels.

DR. E. LEWIS STURTEVANT has presented to the Missouri Botanic Garden, St. Louis, his entire botanical library, which is particularly rich in pre-Linnæan works.

THE question of evaporation from the surface of snow is discussed in a Russian meteorological journal by M. A. Müller, of the Observatory of Ekaterinberg. Authors who have prexiously written on this subject, including Nuckner, Woeikoff, and others, have not been agreed as to whether the evaporation exceeds the condensation from the air in contact with the snow. The method usually adopted has been to compare the temperature at the surface of the snow with the dew point, and assume that if it is superior, evaporation, if inferior, condensation, takes place. M. Müller's observations were made from December 21, 1890, to February 28, 1891. His conclusion is that, according to the method adopted, evaporation is superior to condensation in the proportion of 73 to 27.

THE report of a parliamentary committee on the plague of voles in Scotland shows, on the authority of early Celtic chroniclers, that as early as the year 895 Ireland was devastated by a plague of "vermin of a mole-like form, each having two teeth," which "fell down from heaven," and were driven out only "by prayer and fasting." There is also a plague of voles in Thessaly (a Grecian land), and the Mohammedans there have sent to Mecca for some holy water.

OBITUARY NOTE.

THE Rev. F. O. Morris, of Yorkshire, England, a well-known popular writer on natural history, died April 10th, aged eighty-two years. Among his many books were A History of British Birds, in six volumes, and Natural History of the Nests and Eggs of British Birds.